Research Note 82-12

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MAINTENANCE PERFORMANCE SYSTEM, USER'S REFERENCE MANUAL VOLUME I: SYSTEM DESCRIPTION

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This report describes the final year of a three-year project to develop, implement, and evaluate an Army Maintenance Performance System (MPS). From specific maintenance-related performance measures provided by the MPS, managers and supervisors can assess maintenance effectiveness and relate it to repairmen skills and maintenance training needs. The MPS establishes training priorities, and specifies training resources and methods for overcoming specific deficiencies.

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Item 20 (Continued)

In work completed prior to the final year, a prototype MPS was developed and operated by the contractor staff. Maintenance managers reported that the MPS provided useful, unique, and valid information to aid maintenance operations. During the 46-week period in which the prototype system was operated at Fort Carson, Colorado, the relationships among maintenance workload, efficiency, and skill were studies. As workload increased, efficiency decreased. However, changes in skill levels, through personnel turbulence and/or training, mediated between workload and efficiency. For example, efficiency might actually increase with increased workload, if skill levels increased as well. This finding supported the underlying premise of the MPS, that effort expended on increasing maintenance skills would pay off in increased maintenance effectiveness.

The final year produced a streamlined and expanded MPS that could be handed over to and operated by Army personnel. The system encompassed 10 technical Military Occupational Specialties (MOS's) and the equipment of a mechanized infantry division. The system was proven during a 10-week implementation period at Fort Carson, Colorado. Also, a study of MPS potential in geographically dispersed operations, such as in USAREUR, concluded that the MPS would operate satisfactorily if data collection from outlying units were coordinated with maintenance control system procedures.

A total of 34 reports, manuals, system descriptions, and performance aids were prepared and submitted during the three-year project. These publications provide details on the project and the resulting MPS.

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MAINTENANCE PERFORMANCE SYSTEM, USER'S REFERENCE MANUAL VOLUME I: SYSTEM DESCRIPTION

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FOREWORD

This is **Volume 1** of a two-volume Reference Manual for users of the Maintenance Performance System (MPS). The purpose of the manual is to provide a ready source of reference information and list appropriate background data to help the user understand the development and operation of the MPS. The Reference Manual is one of four documents that have been prepared to support MPS operations.* The remaining documents are:

Operator's Manual - describes methods and procedures MPS operators need to operate and maintain the MPS, including data collection, data entry, quality control, and report generation.

Guide for Individual Technical Training in Direct Support Units - presents the Unit Training Method, a logical approach for accomplishing individual technical training in direct support (DS) units. The guide also identifies *training methods* and *training resources*.

Interpretation Booklet - summarizes report interpretation information contained in the Reference Manual in an easy to use "hip-pocket" format.

The contents of these documents have not been repeated in the Reference Manual unless necessary to clarify a description or discussion. Each document stands alone.

The reader who requires only an overview of the total MPS should study only the System Reference Manual. More detailed information on specific facets of the system will be found in the other documents.

***A note on terminology**

In describing activities and requisites of holders of technical MOS's, the Army has used the term "repairman" in a gender-free context. In the discussions in this manual, use of "repairman," and of "he," or "his," follows Army practice.

The MPS is designed for use at company and battalion HQ levels in direct support units. The system provides unique training and maintenance management information. Primary users of this information are unit leaders. e.g., battalion commander, the battalion materiel officer (MATO), forward support company commanders, maintenance technicians, and non-commissioned officers who supervise maintenance sections.

ORGANIZATION OF THE MANUAL

This manual is divided into two volumes: Volume 1 describes the major components of the MPS; Volume 2 contains samples of MPS data collection forms and examples of each MPS report.

Volume 1: System Description

Volume 1 is divided into four chapters and an appendix, as described below.

Foreword — This describes the purpose of the Reference Manual, the organization and audience, and relates the Reference Manual to other MPS documents. Also included is a summary description of the MPS and a description of the rationale behind its development.

Chapter 1, MPS Description — This chapter describes the scope of the system and its operating environment. Some limitations in the development of the prototype system are also described. MPS system components are described under headings of: data input required for system operation, processing hardware, and required personnel.

Chapter 2, MPS Operation — This chapter describes data collection and computational procedures, and cites the algorithms used to produce reports. Dissemination procedures for the output reports to appropriate users are also described.

Chapter 3, MPS Reports — This chapter provides examples and discussion of representative MPS reports, and identifies recipients of each report.

Chapter 4. MPS Report Interpretation — This chapter describes MPS reports in terms of management and training information and gives examples of possible actions to take based on report content.

Appendix A. Notes on Data Computation and Report Generation — This appendix describes the algorithms used to compute the outputs shown on MPS reports.

Volume 2: Input/Output Examples

Volume 2 is divided into two appendices, as described below.

Appendix A. Input Examples — Samples of MPS data collection forms are provided in Appendix A.

Appendix B. Output Examples — A complete set of examples of all 58 reports is provided as Appendix B.

BACKGROUND, OBJECTIVES, AND MPS USERS

What is the MPS?

The MPS is primarily a training needs information system that helps identify problems related to lack of technical skills, poor utilization of training resources, and poor shop management. The system also helps to pinpoint other unit problems not related to training but which still may affect performance.

The MPS was developed as part of a research program being undertaken for the Army Research Institute (ARI) in an Army-wide thrust to improve maintenance. Maintenance depends to a great degree on the skills of those repairmen who perform maintenance tasks. A key component of any maintenance improvement system is the ability to recognize repairmen's skill deficiencies. A counter to such deficiencies is to provide remedial training at the unit level. The MPS diagnoses training deficiencies in a direct quantitative sense, and enables unit trainers to recommend actions and resources for eventual approval by unit training managers.

MPS Objectives

The overall objective governing the MPS is to improve the conduct and quality of on-the-job training of repairmen on technical tasks in direct support battalions. A specific objective is to provide training managers with a unit-level system for identifying unit and individual training needs. The MPS thus provides specific guidance on what, how, when, and whom to train.

Another important objective is to provide trainers with a system whereby the accomplishment of training is tracked, noted, and "credited" to each soldier's training record.

The current MPS (i.e., the system installed at Ft. Carson in January 1981) evolved from a research approach that included development and installation of a prototype MPS in a Forces Command mechanized infantry division maintenance battalion. A detailed analysis and review of prototype system operation resulted in refinement of its diagnostic capabilities.

MPS Users

System users range from the most senior officer in the direct support battalion, i.e., the battalion commander, to the first-line supervisors in the shop. Table A lists the primary information needs of each user. Additional information on personnel involved in the MPS operation and use is contained in the next chapter.

TABLE A

MPS USER INFORMATION NEEDS BY DUTY POSITION

DUTY POSITION	USER INFORMATION NEED
Battalion Commander	• Overall shop productivity—battalion-wide • Manpower availability and usage • Skill levels—all MOS's • Status of technical training
Materiel Officer (MATO)	• Shop productivity (listed by companies) • Job completion time; time in each repair status • Average time per equipment job
Company Commander	• Effectiveness of company shop • Manpower availability and usage • Job completion time; time in each repair status • Average time per equipment job • Status of technical training
Shop Officer/Maintenance Platoon Leader	• Manpower availability and usage • Job completion time; time in each repair status • Average time per equipment job • Status of technical training (primarily Maintenance Platoon Leader)
Automotive Technician Armament Technician NCO1C C&E NCO1C Service & Recovery	• (Specific to auto section) • Manpower availability and usage • Job completion time; time in each repair status • Average time per equipment job • Status of technical training • Listing of individual's (by MOS) skill levels • Training requirements summaries
Individual Repairman	• Own skill summary by technical task

CHAPTER 1

MAINTENANCE PERFORMANCE SYSTEM DESCRIPTION

This chapter describes the Maintenance Performance System. The MPS is described in terms of its computing system component, underlying data sources, and personnel.

SCOPE

The MPS was designed for use in a divisional maintenance battalion. A prototype system was developed and tested at the 704th Division Maintenance Battalion of the 4th Infantry Division (Mechanized) at Ft. Carson, Colorado. The decision was made at the outset to concentrate on the three forward support companies of the unit to simplify control of the developing MPS. Also, since the prototype was primarily an experimental vehicle for testing the concept of providing special maintenance management and training data, other companies in the battalion, such as "B" Company (Heavy Maintenance) and the HQ and Light Company, were not included. They may be included at some future date prior to DA implementation of the system on a DS battalion-wide level.

The system was designed to cover members of selected technical MOS's who perform maintenance on equipment serviced by the forward support companies of the battalion. An equipment list for each forward support company was developed based on analysis of the inventory for each customer battalion shown in the Battalion Organizational Property Book "roll-up" held by the Divisional Materiel Management Center (DMMC). The list, which directly identifies equipment models and indirectly identifies MOS's that perform maintenance, is shown in Table 1-1.

A task list was developed for each item of equipment maintained by each MOS. The purpose of developing these lists was to describe precisely what technical skills each repairman was expected to possess. The tasks included were those typically performed by forward support companies in mechanized infantry divisions. If a task was not included, it was because the work was not done by repairmen at the forward support level, or the equipment was not in the 4th

TABLE 1-1

BREAKDOWN OF EQUIPMENT LISTED IN MPS BY MODELS AND MOS's

MOS	MPS EQUIP. CODE NO.	EQUIPMENT	MODELS INCLUDED
63H (Tracked Vehicle Repairman) After 1 October 1980	1	M60 family	M60A1 - Tank M60A2 - Tank M9 - Dozer M728 - Combat Engineer Vehicle AVLB Chassis
	2	M113 family	M113A1 - Personnel M106A1 - 81 Mortar M125A1 - 107 Mortar M220 - TOW M548 - Cargo M577A1 - Command Post M901 - ITV
	3	M109/M578	M109A1 - Howitzer M578 - Light Recovery Vehicle
	4	M88	M88 - Medium Recovery Vehicle
	5	Other	All other tracked vehicles
63W (Wheeled Vehicle Repairman) After 1 October 1980	6	M151 family	M151A1 M151A2 M718A1 - Ambulance
	7	Gama Goat	M561 - Cargo M792 - Ambulance
	8	M880 family	M880 - Cargo M881 - Cargo M882 - Cargo M883 - Shelter M884 - Shelter M885 - Shelter M886 - Ambulance
	9	2½/5 ton M series	M35A2 - Cargo M36A2 - Cargo M49C - Fuel M50 - Water M109 - Van M185 - Van M51 - Dump M52 - Tractor M54 - Cargo M813 - Cargo M814 - Cargo M816 - Wrecker M817 - Dump M818 - Tractor

TABLE 1-1 (Continued)

MOS	MPS EQUIP. CODE NO.	EQUIPMENT	MODELS INCLUDED
63H (Continued)	9	2½/5 ton M series (Continued)	M819 - Wrecker M820 - Van M821 - Stake
	10	Other	All other wheeled vehicles
63G (Fuel and Electric Repairman)	11	Brakes	All wheeled vehicles
	12	Carburetors	M151 and M880 series
	13	Distributors	M151 series
	14	Fuel Pumps	All vehicle fuel pumps
	15	Generators/ Alternators	All generators/alternators
	16	Injector Nozzles	All diesel engines
	17	Regulators/Control Boxes	All regulators/control boxes
	18	Starters	All vehicle starters
	19	Other F&E	
52D (Generator Repairman)	20	GED Generator	Gas engine driven generators
	21	DED Generator	Diesel engine driven generator
	22	Other	Material handling equipment and any other equipment
31E (Radio Repairman)	23	RT-246/524 R-442	Receiver/Transmitter, RT-246/VRC Receiver/Transmitter, RT-524/VRC Receiver, R-442
	24	GRA39	Control Group, AN/GRA39
	25	C-2296/7/8	Control, C-2296/VRC Control, C2297/VRC Control, C-2298/VRC
	26	AM-1780	Amplifier, AM-1780/VRC
	27	PRC-77	Radio Set, AN/PRC-77
	28	CVC	Helmet, Combt. Veh. Crewman
	29	TA-312	Telephone Set
	30	Other	All other equipment
41C (Fire Control Equip. Repairman)	31	Aiming Circle	M2
	32	M17 Series Binoculars	M3, M13, M15, M16, M17, M19
	33	M18 Binoculars	
	34	M1 Collimator	
	35	M13 Computer	Ballistic Computer, M13
	36	M1 Quadrant	
	37	M19 Periscope	M19, M24

TABLE 1-1 (Continued)

MOS	MPS EQUIP. CODE NO.	EQUIPMENT	MODELS INCLUDED
41C (Continued)	38	M32/36 Periscope	
	39	M15 Quadrant	M13, M15
	40	M145 Telescope Mount	M145, M146
	41	M17 Rangefinder	M17, M17A1, M17A2
	42	M53 Sight	
	43	M105 Telescope	
	44	M118 Telescope	
	45	M117 Telescope	
	46	M10 Ballistic Drive	
	47	Infinity Sight	8635466
	48	Compass	M2 and Lensmatic
	49	Other	
45K/45L (Tank Turret Repairman/ Artillery Repairman)	50	M60 Tank family	M60A1 - Tank M9 - Dozer M728 - Combat Engineer Vehicle
	51	M109A1 Howitzer	
	52	Other	All other armament work
45B (Small Arms Repairman)	53	M16	Rifle
	54	Cal .45	Pistol, M1911
	55	M203 GL	Grenade Launcher, M203
	56	81mm	Mortar, 81mm
	57	107mm	Mortar, 107mm
	58	M60 MG	Machinegun, 7.62mm, M60
	59	M2 MG	Machinegun, cal .50, M2
	60	M85 MG	Machinegun, cal .50, M85
	61	M240 MG	Machinegun, 7.62mm, M240, M73, M21
	62	Other	All other small arms
44B (Metalworker)		Various	Oxyacetylene Welding Arc Welding Glass Repair Fuel Tank Repair Radiator Repair Body Repair Other

Division inventory. The detailed task lists will not be reproduced here since they are available for reference in Volume 2 of the **Guide for individual technical training in direct support units**, a companion volume to this one.[1]

The MPS was designed to operate in the 4th Infantry Division (Mechanized) as previously noted in this manual. In similarly equipped mechanized infantry divisions and armored divisions, the system will work generally as described, but local deviations in equipment inventory will require some modifications to equipment and task lists. These modifications will involve minor programming changes so that algorithms and computations fit the equipments and tasks being tracked. For example, if the MPS is installed in a division that has M60A3 tanks instead of M60A1 tanks (which are currently covered by the MPS), tasks in turret maintenance will differ, thus task lists would require modification to conform to M60A3 requirements.

But if the "new" division has a radically different equipment suit, repairmen MOS's, maintenance mission and resources, such as in the 101st Airborne Division, then a detailed analysis would have to be conducted and existing MPS programs modified.

COMPONENTS OF THE SYSTEM

The system comprises three major components: information on maintenance performance, a computing system to handle the information, and personnel as operators and users of the system. Each of these is covered separately in the paragraphs that follow.

Existing Maintenance Information. An important concept behind MPS structure is that it is based on use of information already available from various DA forms used in the shop, as prescribed by TAMMS (The Army Maintenance Management System, TM 38-750).

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[1] Simpson, H. K., & Fuller, R. G. **Guide for individual technical training in direct support units. Volume 2. Training reference information.** Santa Barbara, California: Anacapa Sciences, Inc., December 1980.

MPS structure and information flow are illustrated in Figure 1-1. Note the continuous and repetitive cycles of events shown in the figure. Simple maintenance management information originates from the "maintenance job" box. These jobs create maintenance records and assessments which form the "raw" data for MPS processing. Data processing generates performance data which is summarized in easily understood formats for maintenance management.

But note also that the performance data may be further refined to result in diagnoses of maintenance problem areas. One key area is "training problems." The algorithms for "fine-tuning" the training problem area will produce recommended remedial measures and resource listings for training solutions. These are presented to maintenance management for consideration and action.

MPS Computing Subsystem. The MPS generates many millions of data points in a short period of time. Since it was time-consuming, impractical, and not cost-effective to compute these manually, MPS research and development centered around the IBM 5120 computing system on an experimental basis. This system was chosen because this computer (or one with similar characteristics) is scheduled to be part of the Training Management and Control System (TMACS) implementation. TMACS will also be used for local scoring of Skill Qualification Tests (SQTs). The notion here is that the MPS will eventually operate on TMACS hardware at brigade or division level on a mutually arranged time-sharing basis.

The IBM 5120 computing system used in the MPS includes the 5110 Model 3 Computer and an IBM Model 5103 Printer (see Figure 1-2). Although not easily portable, these units are small enough to fit on a six-foot by three-foot table, which represents virtually all the operating space required for the system. (Other requirements are, of course, an operator's chair and filing cabinet.)

The IBM 5120 system characteristics include a 64K internal memory and an external diskette capacity of 2.4 megabytes. The computer has a 9-inch diagonal screen and uses a typewriter-like keyboard which includes a 10-key numeric pad. The printer will operate at 120 characters per second.

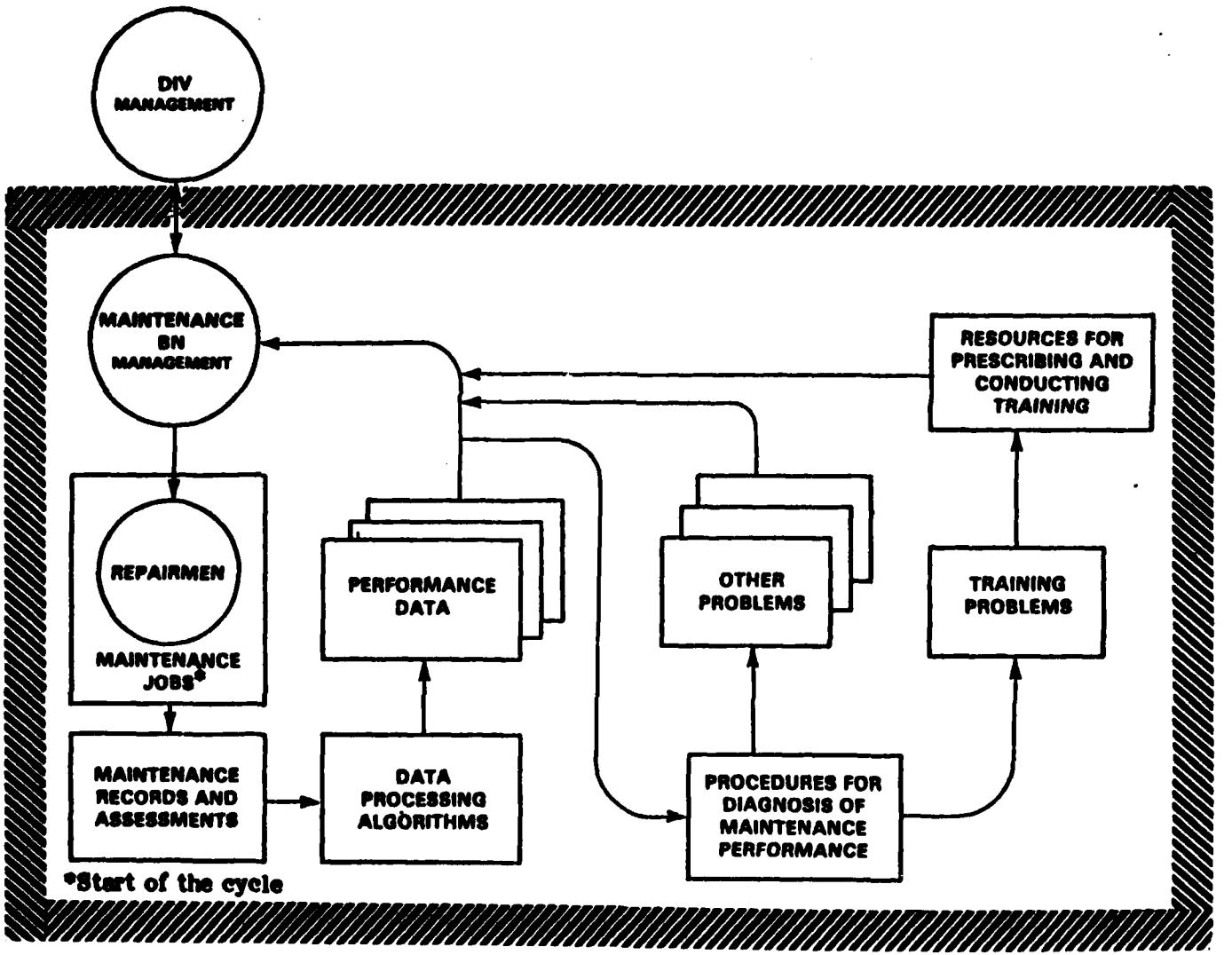
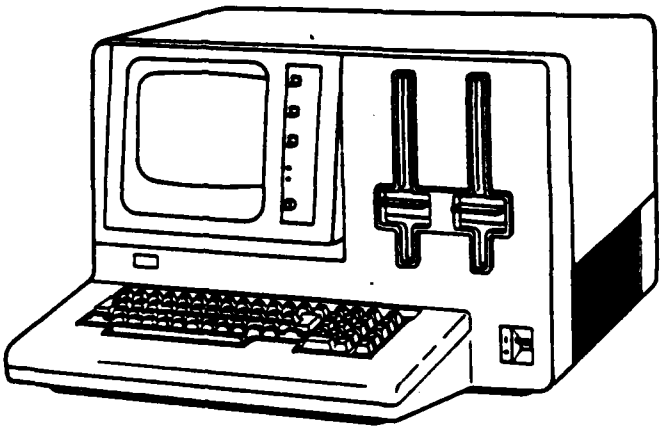
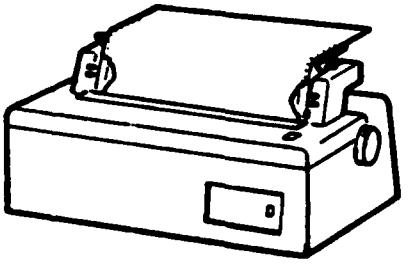


Figure 1-1. Information flow in the Maintenance Performance System.



5110 Model 3 computer



5103 printer

Figure 1-2. Components of the IBM 5120 computing system.

The MPS program required for concept testing and output is written in the BASIC programming language. The program and data for each company are stored on IBM 2D diskettes (see Figure 1-3). The diskettes used in the prototype MPS have a record length of 512 bytes per sector.

The system does not require special wiring and will operate from 115 volt, 15 amp. power supply. The IBM Corporation provides specific and detailed instructions on site preparation and system set-up, as described in references 2 and 3.

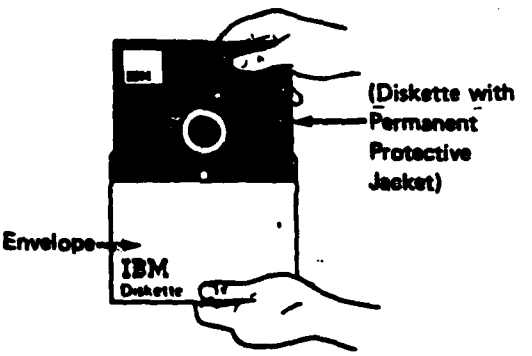


Figure 1-3. Data diskette for IBM 5120 computing system.

[2] IBM 5120 computing system general information and site preparation manual, GA34-0130, Boca Raton, Florida: IBM Corporation, 1979.

[3] IBM 5120 computing system set-up procedure, SA34-0131-1, Boca Raton, Florida: IBM Corporation, 1980.

The MPS contains 22 data files using approximately 0.5 megabytes of disk storage. These are listed in Table 1-2. There are 54 programs, with the program size varying from about 7K of disk storage for the smallest to approximately 22K for the largest. These programs include operating programs and a few program development utilities, as listed in Table 1-3.

TABLE 1-2

DATA FILES USED IN MPS

File No.	File Title/Identifier	Program Code Reference
0001	ASF1.ACTIVE	9 0064,0063 P 01001
0002	ASF2.ACTIVE	9 0090,0088 P 05009
0003	ASF3.ACTIVE	9 0040,0039 P 11009
0004	ROSTER	9 0015,0013 P 13114
0005	ASF5.ACTIVE	9 0016,0015 P 14114
0006	ASF7.ACTIVE	9 0001,0000 P 16001
0007	ASF8.ACTIVE	9 0015,0000 P 16003
0008	ASF9.ACTIVE	9 0001,0000 P 17003
0009	ASF1.PROCESS	9 0050,0003 P 17005
0010	ASF2.PROCESS	9 0010,0000 P 20015
0011	ASF3.PROCESS	9 0003,0000 P 21005
0012	ASF1.CUMULAT	9 0004,0001 P 21011
0013	ASF2.CUMUMOS	9 0001,0000 P 21104
0014	ASF2.CUMTASK	9 0010,0007 P 21106
0015	ASF3.CUMULAT	9 0001,0000 P 22011
0016	GENERAL.INFO	9 0002,0000 P 22013
0017	ASF4.PROCESS	9 0001,0000 P 22102
0018	ASF8.FILEINFO	9 0001,0000 P 22104
0019	SCRATCH.FILE	0 0050, 22106
0020	COPY.PROC	9 0012,0006 26001
0021	COPY.PROC1	9 0012,0006 26110
0022	INSERT.PROGDISK	11 0001,0000 27104

TABLE 1-3

LISTING OF UTILITY AND OPERATING PROGRAMS USED IN MPS

Program Number	Program Title/Identifier	Program Code Reference			
0001	INIT.MPS	11	0001,0000	P	01001
0002	MAIN.DRIVER	12	0010,0003	P	01003
0003	MPS	9	0001,0000	P	01108
0004	MAIN.DRIVER2	11	0010,0003	P	01110
0005	ASF1.FORM	11	0020,0002	P	02015
0006	ASF2.FORM	11	0020,0001	P	03110
0007	ASF3.FORM	11	0020,0005	P	05005
0008	ASF4.FORM	11	0022,0000	P	06015
0009	ASF5.FORM	11	0020,0001	P	07114
0010	ASF6.FORM	11	0010,0001	P	09009
0011	ASF7.FORM	11	0010,0003	P	09114
0012	ASF8.FORM	11	0010,0004	P	10104
0013	ASF9.FORM	11	0010,0006	P	11009
0014	GENERATE.REPORTS	11	0015,0004	P	11114
0015	REPORT.DRIVER	11	0001,0000	P	12114
0016	REPORT.ROSTER	11	0010,0002	P	13001
0017	REPORT.COMMENTS	11	0010,0003	P	13106
0018	REPORT.TABLE1	11	0020,0008	P	14011
0019	REPORT.TABLE2	11	0020,0003	P	15106
0020	REPORT.TABLE3	11	0015,0004	P	17001
0021	REPORT.TABLE4	11	0020,0004	P	18001
0022	REPORT.TABLE5	11	0020,0005	P	19011
0023	REPORT.TABLE6	11	0015,0000	P	20106
0024	REPORT.TABLE7	11	0015,0005	P	21106
0025	REPORT.TABLE8	11	0015,0001	P	22106
0026	REPORT.TABLE9	11	0015,0001	P	23106
0027	ASF1.EDIT	11	0012,0002	P	24106
0028	ASF2.EDIT	11	0012,0001	P	25015
0029	ASF3.EDIT	11	0012,0002	P	26009
0030	ASF4.EDIT	11	0012,0004	P	27003
0031	ASF5.EDIT	11	0012,0001	P	27112
0032	ASF6.EDIT	11	0010,0002	P	28106
0033	ASF8.EDIT	11	0010,0003	P	29011
0034	COMPRESS.ASF1	11	0015,0003	P	30001
0035	COMPRESS.ASF2	11	0010,0000	P	31001
0036	COMPRESS.ASF3	11	0010,0002	P	31106
0037	COMPRESS.ASF4	11	0010,0003	P	32011
0038	COMPRESS.ASF5	11	0010,0003	P	33001
0039	TASK.TITLES	9	0015,0006	P	33106
0040	TASK.INFO	9	0001,0000	P	34106
0041	CREATE.PROC	9	0005,0000	P	36108
0042	INIT.MESSAGE	11	0010,0007	P	39007
0043	INIT.FILES	11	0015,0007	P	35001
0044	PRINT.DATABASE	11	0015,0003	P	37003
0045	ENTER.REFS	11	0010,0003	P	38003
0046	COPY.DATABASE	11	0010,0003	P	42001
0047	COPY.PROC	9	0020,0014	P	40106
0048	INSERT.PROGDISK	11	0001,0000	P	39005
0050	TRAINING.REFS	9	0004,0000	P	38108
0051	WORK.SPACE	9	0001,0000		34108
0052	PRINT.LISTING	11	0006,0000		39112
0056	CLEAR.FILES	11	0010,0002		36001
0057	CLEAR	9	0001,0000		36106

1

A unique feature incorporated in the design of the IBM 5120 system is that the master program diskette and the data diskettes for each company must be inserted into the computer each time it is used—and removed when work is finished. This has several benefits: security of the programs and data are guaranteed—tampering, sabotage, and damage to the programs and data are almost impossible; the same diskette is used month after month as the MPS data base expands and a historical file is built. New data are added to the disk in each new time period.

This data "portability" feature is especially important since the ultimate MPS will be operated on a time-sharing basis on the divisional or brigade minicomputer with other unrelated users.

Personnel. The other major component of the MPS is, of course, the personnel who will use and run the system. These personnel range in duty position from battalion commander to individual repairman.

The **Battalion Commander** has general responsibility for efficient management of maintenance in all shops and for the continued training of repairmen to conduct repairs, and to pass SQT's and contribute to passing ARTEP's. Appropriate summary data from the MPS will be provided to aid him in his decision-making in these two areas.

The **Materiel Officer (MATO)** has an overall interest in shop management and skill level of repairmen, but does not generally take direct personal action to effect changes in shop procedures.

The **Company Commander** has a direct responsibility for shop operations and staff training and will be able to make use of MPS data to highlight specific deficiencies in his operation.

The **Shop Officer, Maintenance Platoon Leader, Maintenance Technicians,** and **NCO's** in charge of sections have responsibilities for shop operations designated by the senior officers in the company. It is unlikely they will initiate training changes without specific authorization or direction from senior personnel. MPS information will, however, be provided to assist them in day-to-day management and supervision.

The **individual repairman**, under present conditions, is not provided feedback on his performance in any systematic fashion. The MPS will provide data that will be useful to the repairman in indicating whether his deficiencies lie in lack of experience or in needed training. It will also provide quantitative data showing when he has reached a required level of performance.

CHAPTER 2

MPS OPERATION

The MPS follows a well-defined cycle involving collection of selected maintenance performance information from shop records, entry of the information into the computer, integration and computation of the "new" data via the operating programs described in Chapter 1, production of reports in various categories, and dissemination of the reports to selected users. Each component of the cycle is described in detail below.

MPS PERFORMANCE DATA COLLECTION PROCEDURES

The MPS operator is assumed to have overall responsibility for collecting data and processing it through the MPS. (The **MPS Operator's Manual** contains comprehensive instructions and explanations of data collection procedures.[4]) Consequently, the present discussion of MPS data collection procedures will provide general background information on key points of data collection rather than specific direction.

The complexity and amount of data in MPS suggest that a specialist should be trained in all aspects of running the system. This task cannot be efficiently performed by unskilled personnel. Unique skills need to be developed for collecting and editing MPS data. The data will be recorded on a series of specially designed forms which were designed to ease the task of transferring maintenance performance data from existing DA forms into a computer-compatible data entry format. Computer entry may thus be made directly from the MPS collection forms without additional work.

The data collection forms and their purpose are described in summary form in the paragraphs which follow. Actual examples of the forms are contained in Appendix A of Volume 2 of this manual.

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[4] Fuller, R. G. **Development of a maintenance performance system for maintenance jobs: MPS operator's manual.** Santa Barbara, California: Anacapa Sciences, Inc., December 1980.

Form MPS-1 (Job Order Status). This form is used to record job progress through the shop. Jobs covered include both "normal" shop work and jobs which have been evacuated. Normal shop work includes:

- Automotive jobs on tracked and wheeled vehicles
- Fuel and electric component work
- Generator section work
- Field radio and telephone equipment (part of C&E section) work
- Fire control, armament, and small arms work
- Metalwork and welding (part of service section)

The MPS-1 form is attached to all job order packets by the Shop Office Clerk. Entries may also be made by the Materiel Supply Clerk and Section Chief. Changes in status will be noted on the form together with the times and dates at which these changes occurred. These forms are filed in two-week blocks by date sequence. They will be retained for reference for the six most recent two-week periods.

Form MPS-2 (Job/Task Performance). For convenience, this form is printed on the reverse side of the MPS-1. Its primary function is to record data on the specific tasks required to complete work on shop repairs, the names of the repairmen who did the work, and the time they spent in direct labor on the job.

The MPS-2 can only be completed for work done in the shop. Jobs which are evacuated and do not have shop tasks performed by direct support personnel will not warrant completion of an MPS-2. Similarly, estimated cost of damage (ECOD) reports (which do not require "hands-on" shop work) will not be recorded on MPS-2 forms. Usually, the team leaders in the automotive section and the NCO in charge of other shop sections will complete the MPS-2 form.

Form MPS-3 (Daily Man-Hour Availability). The entries on this form relate to information concerning repairmen availability, shown as hours available in the shop, hours spent directly working on shop tasks, and overtime. The entries on this form are made by first-line supervisors in a shop section, i.e., team leaders in automotive, and the NCOIC in other sections.

Form MPS-4 (Roster Update). The MPS-4 is used by the system operator to record changes affecting the MPS roster of personnel. This information is derived from records maintained in the company orderly room. It is used as a basis for

determining which persons have been newly assigned to (or detached from) those duty positions covered by the MPS. This form provides the basis for those records maintained in the computer to compute man-hours for later inclusion in management reports. Once these data are entered in the computer, the form is discarded.

Form MPS-5 (Training/Performance Demonstration). The MPS-5 is used to record technical training provided to repairmen to help them master technical tasks. The MPS-5 is also used to record the demonstration of competence on a technical task. The concept of this form is similar to that of a soldier's Job Book. The form is completed each time a repairman receives technical training or demonstrates performance. The form is primarily used by those designated as trainers. It is discussed in detail in the **Guide for individual technical training in direct support units** (see Reference 1). The data are recorded by the person providing the training (i.e., the instructor), or the person with authority and expertise to accept a performance demonstration as satisfactory (e.g., a W.O. Technician).

These forms are filed by Julian date sequence in six-week blocks.

Form MPS-6 (Task Experience History). This form is used to record the experience a repairman has had performing tasks listed in the MPS. It spans the period from when he graduated from AIT to the time his name is entered in the MPS.

When the MPS is implemented in a unit, all personnel assigned will fill out an MPS-6 form for their particular MOS. After the initial implementation, personnel who are subsequently assigned to the unit must complete an MPS-6 for later entry into the system. MPS-6 entries can only be made by individual repairmen since the Army does not typically maintain records of repairmen's work or training experience.

Form MPS-7 (Special Priority Flag). This form is used to record special training priorities that must be added to, or deleted from, the computer-generated training requirements list. Training managers and trainers in the unit are responsible for designating these special priorities. A detailed explanation of these priorities and the rationale behind their application is contained in the **Guide for**

individual technical training in direct support units (see Reference 1). The MPS-7 will be completed by the operator from instructions provided by the company commander, in his role as training manager. Use of this form provides flexibility not usually obtainable in a computer-driven system. Its effect is to provide a manual override on computer-generated training requirement priorities.

Form MPS-8 (Interpretation Comments). This form is used to record narrative information for display on the MPS Interpretation Comments report. This information may be referred to by system users for aid in report interpretation. It is important that managers should be aware of special conditions that may influence interpretation of the reports. Examples of such conditions are unit field training, adverse weather conditions, special tests, and FORSCOM-designated priorities such as IG inspections.

The information is provided by senior battalion and company personnel and recorded by the MPS system operator.

Form MPS-9 (Training Requirement Priority Threshold). The priority of each training requirement is computed as a function of generating MPS Table 9 for each MOS (Training Requirements Summary). Priorities range from 1 to 7, where 1 is highest priority and 7 is lowest. Priorities are calculated through an equation which considers number of people needing training, and the group average skill level on the technical task that underlies the training requirement. The MPS-9 form can be used to control the number of training requirements listed on MPS Table 9. The computer algorithm will only permit tasks with priorities equal to or higher than a set threshold to be listed on Table 9. Thus, the higher the threshold is set, the fewer training requirements will be listed. Reference 1 describes the concept of the threshold in greater detail.

Training managers and trainers make threshold assignments by informing the MPS operator where they should be set. The MPS Operator in turn enters the threshold level into the computer.

Summary of MPS Form Data Entry Responsibilities. Table 2-1 summarizes the contribution of maintenance personnel to each MPS form discussed above. Note that although the MPS operator is involved with all nine forms, he is solely responsible for entries on the MPS-4 and MPS-8.

TABLE 2-1

CONTRIBUTIONS OF MAINTENANCE PERSONNEL TO MPS FORMS

MPS Form	Shop Office Clerk	Materiel Supply Clerk	Section Chief	Team Leader	Training Manager	Trainer	Repair-man	MPS Operator
1	X	X	X					
2			X	X				
3			X	X				
4								X
5					X	X		
6							X	
7					X			X
8								X
9					X			X

Data Computation

The computation of the data reflecting maintenance job performance and its transformation into usable reports is a function of the specially developed program described previously in Chapter 1 under components of the system. The printed listing of this program represents a total of some 450 pages of program instructions. Each program and subroutine listed in Tables 1-2 and 1-3 include not only the algorithms used to transform the data from the "raw" form in which it was collected into usable reports, but also provide: the instructions for data entry; "prompts" for the system operator; formatting of the reports; a series of error warnings to alert the operators for incorrect entries of data; and signals of malfunctions of the 5120.

The programs also include a facility for editing, i.e., correction, of the data base, and a facility for compression of the data base as accumulated information grows. If this data base compression routine were not invoked, the stored

information would proliferate beyond the capacity of the system. The compression routines developed include a "roll-over" routine whereby data beyond a certain period will be summarized and the total display "rolled-over" by one period. Thus, the oldest line on the report will disappear and a new line will appear at the bottom of the display. The totals from the data summary on the report will be used for averaging and trend development. The need to store individual entries from MPS forms in their original format for an indefinite period is thus eliminated.

The finished program will be documented in detail to permit its maintenance or modification by other programmers. The documentation elements will include comment/remark lines, file descriptions, and function definitions. The documentation will take the form of a printout of the program listing and an accompanying program manual containing explanatory comments.

The MPS design is based on use of two separate diskettes. All programs are modular. The operating program will use drive 1 of the IBM 5120 Computing System. Field data will be kept on a separate diskette used on drive 2 of the IBM 5120. This procedure will be followed throughout system operation. The system is designed to handle data for up to four different companies within a battalion. The same operating program will be used for all companies by substituting different field data base diskettes in drive 2. Each company-specific data diskette will be clearly identified to reduce the possibility of inputs being entered into the wrong data base. An additional safeguard in the program design is that an error message will appear on the screen if the company-specific reference in the operating program and data disk do not match.

The MPS is designed so that computation can be made for entries keyed to the Julian calendar whereby each date is represented by a four-digit number. The system has a capability of accepting data for the 10 years commencing in 1980 and ending in 1989. After 1989 the data generation subroutines will require minor modification to handle the next decade. (A subroutine translates Julian dates to Gregorian dates when generating report headers.)

The data input programs may be selected from a main "menu." The subsequent entry of data using these programs is error-checked for range, type (numeral vs alpha character), and completeness. For example, if a date time group (DTG) entry requires eight digits and the operator enters nine or seven digits, an error message will appear and permit entry correction. The operator will also be able to edit earlier form entries before proceeding to the next form in the series.

The algorithms used to generate summary reports are included and discussed in detail in Appendix A. These algorithms are included as a reference source to aid interested MPS users in understanding how the MPS computes times, quantities, and training requirements from the raw data.

The MPS Operator

The MPS is capable of being operated by a specialist who has received unique training in running the system. Operator characteristics include some degree of skill in typing and understanding of maintenance procedures. Background in computer operation is not necessary.

A one-week training course was conducted for the system operator prior to assignment for on-site operation of the system. The training course consisted of: background review of the MPS, "hands-on" practice in operating the IBM 5120 computing system, a detailed description of data collection requirements, practice in collecting data from maintenance reporting documents generated in forward support shop offices, and diagnosis and correction of data entry errors.

The operator's duties and details of specific components of MPS operation are described in the **Operator's Manual** (see Reference 4).

The system operator does bear strong responsibility for collecting data from up to three forward support companies. He will be responsible for correcting such deficiencies or inaccuracies as may occur in data supplied by shop personnel—e.g., information connected with direct man-hours expended on job tasks. Also, because of work pressures, team leaders and section chiefs may occasionally postpone relevant entries on MPS forms, thus increasing the possibility of error. The MPS operator will be responsible for reducing the amount of error caused by improper or

untimely data recording. Operating procedures will require that he set up a schedule for collecting information from the various technical sections within the forward support companies on a routine and structured basis. He will also be required to develop a schedule that will permit him to enter data into the IBM 5120 or equivalent computer. This will become particularly important when the MPS is transferred to the TMACS mini-computer at division or brigade HQ and computer time will only be available on a shared basis.

A formal schedule for recording senior officers' comments, and requirements for priority training listings, will be required. However, although the MPS operator has a key responsibility for successful system operation, the primary responsibility and oversight of the MPS must devolve on those senior officers concerned with maintenance training and management. It may be appropriate to allot responsibility for training components of the MPS to the battalion S3, and for management components of the MPS to the MATO.

CHAPTER 3

MPS OUTPUT

The rationale underlying the MPS is that it will improve the performance of maintenance by providing training at the unit level for maintenance personnel, and that shop management will improve by having access to management information not previously available. The MPS reports serve as the vehicle to provide information necessary to accomplish these objectives. This chapter reviews MPS reports, formats, and report distribution . A complete set of examples of all 58 reports is contained as Appendix B of Volume 2 of this manual. The reader will benefit by having the examples on hand while reading this chapter.

OUTPUT FORMAT

The reports are printed on 9.5 inch width tractor feed printer paper suitable for use in the IBM Printer 5103 or equivalent machine. The actual display width is 8.5 inches. The display area is limited to a maximum width of 7.5 inches and a length of 9 inches on the sheet. All reports have a similar format. Since there generally will be only one copy of each report produced on the printer, xerox-type reproduction is simplified by standardizing the format.

To assist report identification, all header, content, and distribution information begins at the left margin.

The header contains the following information:

- Company and battalion
- Table #, title, and date (Julian and Gregorian)

The information display (content) always begins 2-3/4 inches below the top of the first page of each report. If the report continues to a second page, the header is not repeated although identifier information is printed at the top of the second page. Left and right margins are nominally 1 inch in width to provide binding and notation space.

REPORT CONTENT

For ease of interpretation, the MOS's covered by the MPS were grouped into the five categories shown below. These five technical categories correspond to the technical sections in forward support company shops. They are summarized in Table 3-1.

TABLE 3-1

MOS's IN MPS GROUPED BY TECHNICAL CATEGORY

Technical Category	MOS's Included
Automotive	63G, 63H, 63W
Generator	52D
Armament	41C, 45B, 45K, 45L
Communications & Electronics (C&E)	31E
Service & Recovery (S&R)	44B

To make full use of each sheet, some MPS reports show information for more than one MOS on the same sheet. When this was necessary, the reporting combinations were selected from the same technical category wherever possible.

The designators for the MOS's, i.e., 31E, 45K, etc., form a logical ascending numerical sequence. In general, the report columns were formatted so that this sequence was followed from left column to right.

The MPS reports include nine different generic categories of tables. Eight of these nine table groups have formats that are repeated in slightly differing versions for each MOS, to display MOS-specific data. To emphasize the similarities within generic table groups, all table variants in a table group are assigned the same number, but are identified as being unique by including the relevant MOS code listed parenthetically after the table number in the header. The nine generic groups of tables (reports) are further broken down into 58 separate reports, which include a set of Interpretation Comments and a Repairmen Roster, in addition to the tables themselves. The titles of the reports included in the MPS are listed in Table 3-2, with the number of variants given for each.

TABLE 3-2

MPS TABLE NUMBER BY GENERIC GROUPS AND NUMBER OF VARIANTS

MPS TABLE NUMBER	TITLE	VARIANTS
—	Roster	1
—	Interpretation Comments	1
Table 1	Man-hour availability and use	9
Table 2	Average direct man-hours per job	5
Table 3	Average direct man-hours per job by equipment and task	9
Table 4	Average job throughput time in days	5
Table 5	Average days spent in each job status	5
Table 6	Skill and growth indexes	4
Table 7	Skill development summary	1
Table 8	Individual skill history	9
Table 9	Training requirements summary	9
	TOTAL	58

Although the information in the MPS is interlocked and integrated to a high degree, the reports may still be categorized under headings of maintenance management, and training information. Thus, Tables one through five contain maintenance management information reflecting various aspects of maintenance efficiency, effectiveness, and personnel availability. Tables six through nine contain information reflecting various aspects of skill, training, and training management.

The roster is not distributed but is maintained by MPS operators as a "housekeeping" component of the MPS. The roster is provided only to the company office for use in tracking newly assigned personnel and recent departures.

The interpretation comments are given in a separate report. They are provided so that recipients are aware of local conditions or requirements that should be considered during report interpretation.

DISTRIBUTION

Each report has been allotted a unique reference number from 1 through 58 (always located at the bottom left of each sheet). This number is primarily for the system operator's use in collating tables into sets for distribution to users. Each user has been given a unique code number. Table 3-3 below shows the code number of the 11 "users" of MPS information.

TABLE 3-3

USERS' CODE NUMBERS

DISTRIBUTION CODE NUMBER	USERS
1	Battalion Commander
2	MATO
3	Company Commander
4	Shop Officer
5	Maintenance Platoon Leader
6	Automotive Maintenance Technician
7	Armament Technician
8	Communications and Electronics NCOIC
9	Service and Recovery NCOIC
10	Company Office
11	Individual Repairmen (listed by name)

The frequency of production of the reports varies according to content and user. For example, the **maintenance management reports** (Tables one through five) are generated every two weeks and distributed to commanders, maintenance managers, and senior supervisors. The **skill/training reports** (Tables six through nine) are generated every six weeks and distributed to training managers and trainers. The reason for the longer interval between distributions of skill training reports is because the effect of training on individuals is not so apparent in short time periods of one or two weeks duration.

The overall **Skill Development Summary** (Table 7 in the skill training report group) is distributed to commanders only since it summarizes the status of all MOS skill levels.

Each individual repairman will receive a copy of his **Individual Skill History** (Table 8) every six weeks. A copy will also be kept on file for use by the training manager.

The **Repairmen Roster** as used in the MPS is generated every two weeks and a copy provided to the company office for background information and updating.

Interpretation Comments are provided to all system users with each distribution. The distribution interval and number of reports received by MPS users is summarized in Table 3-4 following.

TABLE 3-4

DISTRIBUTION INTERVAL AND NUMBER OF REPORTS RECEIVED BY MPS USERS

USERS	BI-WEEKLY REPORTS	SIX-WEEKLY REPORTS	TOTAL
Bn Cdr	20	5	25
MATO	25	0	25
Company Cdr	34	5	39
Shop Officer	34	0	34
Maint. Plat Ldr	32	14	46
Automotive Tech.	17	12	29
Armament Tech.	11	8	19
C&E NCOIC	6	4	10
S&R NCOIC	6	4	10
Company Office	2	0	2
Individual Repairman	0	1	1

Note that the three user groups who receive the most reports are Company Commanders, Shop Officers, and Maintenance Platoon Leaders. This is to be expected since the MPS has throughout its development been focused on providing unit-level training and management information to unit supervisors as the basis for actions which will improve maintenance effectiveness.

CHAPTER 4

INTERPRETATION OF MPS REPORTS

The focus of this chapter is on interpretation of those MPS reports designed to reflect maintenance conditions and training needs in a DS unit forward support company. Even though summarized and unique information will be provided in these reports, it is recognized that the complexity of DS shop maintenance in a changing environment makes it difficult to always isolate specific causes for changes in routine measures of productivity.

This chapter will therefore discuss options in interpreting MPS output reports and provide explanatory examples where appropriate. Since constant reference will be made throughout the discussion to report tables identified by distribution code numbers, the reader will benefit by having Appendix B of Volume 2 of this manual readily available.

The reader is reminded that the purpose of this chapter is primarily to help the user's understanding of MPS outputs. The examples and procedures provided are illustrative only and should not be considered as operational doctrine or representative of real-life maintenance conditions.

A separate description of interpretation options will be contained in the **Interpretation Booklet**[5] produced as the fourth document in the Maintenance Performance System publication series. The Interpretation Guide will be a "hip pocket" summary of interpretation information.

RATIONALE GOVERNING MANAGEMENT REPORTS

Maintenance managers are primarily concerned with the effectiveness of maintenance performance. Maintenance **effectiveness** overall is a function of three variables—efficiency, quality, and productivity.

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[5] Harper, W. R. **Development of a maintenance performance system for maintenance jobs: interpretation booklet.** Santa Barbara, California: Anacapa Sciences, Inc., January 1981.

Maintenance **efficiency** is reflected by use and application of resources such as personnel, tools, facilities, and repair parts. Efficiency also relates to the rate at which work can be performed. If resources are used well, maintenance efficiency will increase. If resources are misused or wasted, efficiency will drop.

Maintenance **quality** relates to how well work is done and the results of the work. Maintenance work in the Army (or any large organization) requires following proper maintenance procedures, using correct materials and tools, and working to appropriate standards for the task. Acceptable results of maintenance tasks depend on accuracy and completeness of work. If an equipment fault is not corrected or only partially corrected, work quality is deficient. In a direct support maintenance operation, quality level is closely related to inspection level, i.e., poor quality of finished work suggests inadequate inspection procedures.

Productivity is a measure of the amount of maintenance work done, e.g., the number of jobs completed during a particular time interval. Productivity does not measure efficiency or quality. One can have a high level of productivity and a correspondingly high level of rejects because of faulty performance. The ideal target for maintenance managers is to aim for a high level of productivity and a low level of rejects or rework.

All of these together reflect maintenance **effectiveness**. An effective maintenance operation, then, is one that is productive, efficient, and that produces work to an accepted criterion of quality.

The management reports discussed below are included in MPS Tables 1-5. They are:

- Table 1 - Man-hour Availability and Use
- Table 2 - Average Direct Man-hours per Job
- Table 3 - Average Direct Man-hours per Job by Equipment and Task
- Table 4 - Average Job Completion Time in Days
- Table 5 - Average Days Spent in Each Job Status (for specific technical area jobs)

To avoid redundancy, only one example of each table is described in detail in this chapter to clarify interpretation options. Each table cited is identified by both its MPS table number and by its unique reference number in the 1-58 number series contained in Appendix B of Volume 2.

REPORT INTERPRETATION

Discussion of each report will include:

- Brief description of purposes and components (column headings)
- Source(s) of information from which the output report will be derived
- Computation, integration, and formatting of the report
- Interpretation options and actions

Man-Hour Availability and Use—Table 1, Ref. 4

(See Figure 4-1 for example of Table 1.) There are six manpower utilization measures. They show assigned man-hours, number of manpower hours available, number of man-hours spent on direct labor, number of man-hours overtime, ratios of available-to-assigned, and direct-to-available man-hours. These are defined below.

Assigned man-hours refers to the number of men in the company assigned to a particular MOS. Not only does it include men who are assigned to the MOS but also those who may have another MOS but are working on a semi-permanent basis in the MOS reported on in the table. Data on Paygrades E1 through E5 only are shown. (Paygrades E6 and above are considered supervisory and typically do not perform repair tasks in the shop.)

The computer program will access the roster file maintained in the computer by the system operator. The computer program has been designed so the number of man-hours shown as assigned in an MOS will be computed automatically from the roster of men present during the ten working days of each reporting interval.

'E' CO. 704 MAINT. BN.

TABLE 1 (41C): MAN-HOUR AVAILABILITY AND USE

REPORTING PERIOD ENDING: 0354* (19 DEC 80)

REPORTING INTERVAL JULIAN DATES	ASSIGNED MAN-HRS	AVAIL-ABLE MAN-HRS	DIRECT MAN-HRS	OVER-TIME MAN-HRS	PERCENT AVAIL/ ASSIGNED MAN-HRS	PERCENT DIRECT/ AVAIL MAN-HRS
0187-0200	3512	2523	1744	14	71.8	69.1
0201-0214	3440	1336	571	50	38.8	42.7
0215-0228	3200	1692	502	0	52.9	29.7
0229-0242	3120	1134	656	0	36.3	57.8
0243-0256	3184	1484	664	0	46.6	44.7
0257-0270	3120	1464	760	0	46.9	51.9
0271-0284	3120	1284	819	0	41.2	63.8
0285-0298	3112	1319	591	0	42.4	44.8
0299-0312	3608	1492	622	0	41.4	41.7
0313-0326	3056	1609	636	32	52.7	39.5
0327-0340	3160	1656	1566	2	52.4	94.6
0341-0354*	3600	2086	1814	79	57.9	87.0
AVERAGE FROM LISTED TIME PERIODS						
0187-0340	3289	1588	937	13	48.1	57.1

REF# 4 DIST 1 3 4 5 7

Figure 4-1. (41C): Man-hour availability and use (Table 1, Ref. 4).

Available man-hours refers to the number of MOS-specific man-hours available to perform work in the shop or field during normal weekday working hours. Available hours does not include absences from the shop for appointments, tests, training, sick time, or compensatory time off. Available personnel may be engaged in direct labor on maintenance jobs, on indirect labor, or may even be non-productive.

This measure is computed from information accumulated by the appropriate first-line supervisor in a shop section. The names and availability of men under his control are recorded on a special form (MPS-3).

Computation of the available man-hour totals reported in Table 1 will be done automatically by the computer. The hours available for each man will be summed and presented as a total for all men in that MOS.

Direct man-hours represents the number of man-hours whereby personnel were actually involved in direct labor on maintenance jobs. Direct labor is defined as hours a repairman performs maintenance on any vehicle or other equipment during normal duty hours. It includes "hands-on" time and any job-related action such as getting parts or tools, making inspections, completing job-related DA forms, and looking for information in a technical manual. (Time spent on shop overhead activities is not chargeable to a particular job and are not included in direct labor totals. Examples would include shop cleaning, painting, and the like.)

"Overtime man-hours" represents the number of man-hours spent on overtime work by a repairman in the shop either before or after normal duty hours. This time is recorded whether or not it was spent working on a specific job (direct labor). Time spent in the field waiting for repair work in off-duty periods may be counted as overtime. However, unit tactical training and administrative activities in the field, such as time spent eating or sleeping, are not counted as overtime. Overtime data are derived from the same sources as available and direct hours.

These hours are also summarized in the reports automatically by the computer from data recorded by the first-line supervisor.

Percent available to assigned man-hours represents a ratio (expressed as a percentage) of the degree of availability of personnel to perform maintenance work. The ratio expresses the proportion of man-hours available to perform maintenance work against man-hours assigned according to TO&E.

Percent direct-to-available man-hours is represented by a similarly computed ratio showing the degree to which personnel available for work during regular hours were productively engaged in direct labor on maintenance jobs. Figure 4-1 showed an example of man-hour availability and use for MOS 41C.

The data in MPS Table 1 are representative of those obtained under field conditions. The reporting period is shown in Julian format (0354) and also by the Gregorian calendar (19 DEC 80). The current reporting period is always shown on

the second to last line of the table, marked with an asterisk. The averages shown at the bottom of the table and so titled, represent those computed from data in the listed time periods on the table. (Tables were so designed that six months of data can be shown at one time.) As a six-month period is exceeded, the oldest information will be removed and the newest information printed at the bottom of the table.

This table may be interpreted in several ways. For a quick overview the user should scan the two right-hand **ratio** columns. Note the differences between the available-to-assigned man-hours and between the direct-to-available man-hours. These ratios are 57.9 percent and 87 percent, respectively, in the example in Figure 4-1. As the data base increases so does the opportunity to compare current data with those previously listed.

But examining the ratio columns alone is not adequate for a detailed analysis. The numerical data in the four columns to the left of the ratio should also be examined. Note for example the information in Julian period 0313-0326. The **assigned** man-hours for this period were 3056, a difference of 552 man-hours from those listed in the previous period. The user's action might include investigation of whether personnel had left the unit and no replacements had been obtained, whether there were reassignments to other companies, to other battalions within the division, or whether there was an error in man-hours accounting and bookkeeping.

During the same period note the comparison between **available** man-hours (1609) and **direct** man-hours (636). Although the ratio between assigned and available is 52.7 percent, the ratio between direct man-hours and available man-hours has dropped (39.5 percent). In addition, 32 hours overtime were required to get the work out. The long-term average ratio between direct and available man-hours for the six-months listed is 57.1 percent. A wide disparity such as this suggests that shop personnel are spending too much time on indirect labor. A certain amount of indirect labor is inevitable but an excess suggests poor manpower utilization by shop supervisors.

Increase in **overtime** man-hours indicates inability to cope with workload using current resources. The reasons may stem from inefficient use of personnel,

lack of personnel, poor scheduling, higher-than-normal workload, lack of cooperation from customers bringing work on time, the need for training of repairmen, and improper management of resources. If investigation reveals there are no unusual maintenance demands during the reporting period, and overtime man-hours are higher than normal, the problem may lie with shop management or lack of coordination between technical sections in the shop.

Average Direct Man-Hours per job—Table 2, Ref. 12

(See Figure 4-2 for example of Table 2.) This table will show the average amount of time in hours for each job done by a specific MOS. In addition to the average hours per job, the number of jobs done in the current period is also shown so the user may assess the validity of the reported information. Since this table provides data for up to a period of six months, the user may also compare "average hours" for previous periods. This table is only used to show work actually done in the shop. It does not refer to jobs which were evacuated.

Data recording of job times is done on a simple form (MPS-2) submitted when the task is finished. Computation of the data is done by the computer through summation of the total number of repair man-hours expended on each vehicle or piece of equipment, and dividing by the number of jobs in that category.

Note that on the table cited, four MOS's are shown, 41C, 45B, 45K, and 45L. MOS 45K and MOS 45L are shown in combined form (i.e., 45K/L). This was required because these repairmen (though classified as holding an individual MOS specialty) have interchangeable skills on each other's MOS-specific armament jobs. The two major items worked on by these MOS's include the M60 group of vehicles and the M109.

The "other" column shown on the table refers to one-of-a-kind jobs which may come in at infrequent intervals. (The frequency of the tasks shown as "other" on these unique equipments is such that it would not be cost-effective to include them as a separate table since no data would be collected for much of the year).

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TABLE 2 (41C/45B/45K/L): AVERAGE DIRECT MAN-HOURS PER JOB

REPORTING PERIOD ENDING: 0354* (19 DEC 80)

REPORTING INTERVAL JULIAN DATES	MOS 41C		MOS 45B		MOS 45K/L						
					M60 FAMILY		M109		OTHER		AVG. HRS.
	AVG. HRS.	NO. JOBS	AVG. HRS.	NO. JOBS	AVG. HRS.	NO. JOBS	AVG. HRS.	NO. JOBS	AVG. HRS.	NO. JOBS	45K/L JOBS
0187-0200					23.3	12	28.0	3			24.2
0201-0214	22.7	3	22.7	3	23.4	7	25.3	3	25.6	4	24.4
0215-0228	31.0	2	31.0	2	21.6	14	21.7	3			21.6
0229-0242					16.4	9	15.2	5			16.0
0243-0256	22.0	2	22.0	2	14.1	16	11.5	2	33.0	3	16.6
0257-0270					10.2	13	24.0	4			13.4
0271-0284					10.1	17	17.6	5			11.8
0285-0298	18.0	1	18.0	1	14.6	5	15.5	6			15.1
0299-0312	29.0	1	29.0	1	9.8	15	17.2	9	29.5	2	13.9
0313-0326	38.0	2	38.0	2	13.1	7	17.5	6	38.0	1	16.8
0327-0340					1.7	3	40.7	3			21.2
0341-0354*	20.0	1	20.0	1	14.4	7	27.3	3	-		18.3
AVERAGES FROM ALL PREVIOUS TIME PERIODS											
0000-0340	24.2	12	19.9	12	21.6	125	20.8	52	31.5	10	23.4

REF# 12 DIST 2 3 4 5 7

Figure 4-2. (41C/45B/45K/L): Average direct man-hours per job (Table 2, Ref. 12).

At the bottom of Figure 4-2, note that averages are computed from all previous time periods. This means that although six months of data are listed on the table, data from all previous time periods is stored so that the "number of jobs" will accumulate and thus increase the validity of the overall averages.

This measure provides an index of the efficiency of maintenance personnel performing maintenance jobs. As efficiency increases, the rate (time taken) at which they can perform these jobs should decrease. The measure assumes that work quality remains constant but that skill and other variable factors may change. Note on the example that the tasks done by MOS 41C during the current period

were done in substantially less time than the average time taken for those tasks. But also note that the work done in the current period on the three jobs on the M109 by 45K/L repairmen took substantially longer than the average. Good maintenance management requires that the supervisor investigate the causes of the difference. One possibility is that shop management is not exercising enough control over shop work, or perhaps a new intake of apprentice-level (and thus low-skilled) repairmen are working on these jobs.

In the armament work done on M60's by MOS 45K/L, note that the work done on the seven jobs listed required only 60 percent of the average time for that job. The reason for this should be investigated since the shortened performance time may reflect results of training undertaken in the previous period. Or possibly the nature of work in the armament area is becoming less difficult because of better organizational level maintenance. The maintenance manager/supervisor/technician should be aware of the reasons causing change since this knowledge will assist him to supervise his technical area more efficiently in the future.

Average Direct Man-Hours per Job by Equipment and Task—Table 3, Ref. 17

(See Figure 4-3 for example of Table 3.) This table specifies for the maintenance manager the average time over an extended period taken to perform a specific task on a listed equipment item. This time may be compared with the average time taken to perform the same task during the current period. The number of jobs from which both averages are derived are shown so the user may assess the validity of the reported data. (A blank space in the current average indicates that that particular task was not performed during the current period. Frequency and type of incoming repairs are variables over which the maintenance shop has no control.)

This measure is derived from data already stored in the computer data base. These data were originally used as a basis for Table 2--Average Direct Man-hours per Job (Figure 4-2).

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TABLE 3 (31E): AVERAGE DIRECT MAN-HOURS PER JOB BY EQUIPMENT AND TASK

REPORTING PERIOD ENDING: 0354* (19 DEC 80)

EQUIPMENT/TASK	MAN-HOURS PER TASK: NO. JOBS	AVG. FROM PREV PERIODS	CURRENT AVG.	CURRENT NO. JOBS
RT-246/524, R-442				
1 ALIN DVR & PWR AMP	2	9.0		
2 ALIN SERVO SYS (246)	1	4.0		
3 ALIN IF RCVR A4000	23	7.6	21	6
4 ALIN VHF TUNER A1000	5	3.4		
5 ADJ AUDIO SQUELCH A5000	2	14.5		
6 PERF PREALIN CK DVR&PWRAMP	2	9.0	9.2	2
7 ALIN MAST OSC & BUFR AMP	5	3.4		
8 REPL MODS IN RCVR, R-442	1	1.0		
9 REPL MODS IN RT-246/524	1	5.6		
10 REPL PARTS IN FRNT PNL ASSY	20	12.2		
11 REPL INTERCNCT MOD CABLES	1	10.0		
AN/GRA 39				
1 REPL BUZZER	20	1.3		
2 REPL BATTERY BOX	3	4.7		
3 REPL CARDS	2	10.5	10.2	1
4 REPL MOD	1	1.0		
5 REPL AUDIO PLUGS	3	1.0		
6 REPR WIRING	9	9.2	9.0	2
C-2296/7/8/9				
1 REPL AUDIO PLUG	15	1.4		
2 REPL VOLUME CONTR	2	1.0		
3 REPL MOD	5	2.5	2.3	2
4 REPR WIRING	1	3.0		

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•This column used for special training purposes and is not related to man-hours per task reporting.

Figure 4-3. (31E): Average direct man-hours per job by equipment and task (Table 3, Ref. 17).

The "number of jobs" listed in the first column on the left shows the number of jobs completed during all previous reporting periods. The "number of jobs" listed on the right side of the table refers only to those jobs completed within the current reporting period.

Maintenance managers often find it difficult to assess shop effectiveness and manpower allocation. Comparative measures to evaluate these areas are rare. This table will provide averages for comparative purposes. Since these averages are compiled from real shop data under the special environmental conditions and resources available to the direct support company, they will have a high degree of validity. The exemplary data reported here in the current average column (i.e., 21, 9.2, 10.2, 9.0, and 2.3 man-hours, respectively) suggest the man-hours expended per task fits the trend of time taken for the work reported. It suggests no immediate management action is necessary. But if the task time for a specific job was greatly in excess, or below that reported for the historical trend average, management action is warranted to investigate the cause of the discrepancy.

For example, excessively high man-hours could be caused by unusually difficult working conditions, parts breaking off in position during removal, or by lack of tools and resources needed to complete the job.

Excessively short completion times could be due to highly skilled repairmen being assigned to the job for the first time or even for some vital part of the task being omitted. If a comparison of data from previous tables in the series showed that the current average man-hours were gradually being reduced it would suggest that skill of the repairmen is increasing, thus decreasing the time taken to do the task.

Average Job Completion Time in Days—Table 4, Refs. 26, 27, 29

(See Figure 4-4, 4-5, and 4-6 for examples of Table 4.) The information in these tables represents the total elapsed time from receipt of a job at the DS company to the time of the job being picked up by the customer. The times shown are average days computed from the number of jobs completed in a listed Julian time period. "Job start" time commences when work is accepted by the DSU shop and ends when all paperwork is returned to the shop clerk and the customer picks up the vehicle.

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TABLE 4 (31E/44B): AVERAGE JOB COMPLETION TIME IN DAYS

REPORTING PERIOD ENDING: 0354* (19 DEC 80)

REPORTING INTERVAL JULIAN DATES	MOS 31E AVG. DAYS	MOS 31E NO. JOBS	MOS 44B AVG. DAYS	MOS 44B NO. JOBS
0187-0200			28.0	45
0201-0214	22.7	3	32.0	1
0215-0228	31.0	2		
0229-0242			24.0	2
0243-0256	22.0	2	22.0	2
0257-0270			61.3	3
0271-0284				
0285-0298	18.0	1	12.3	3
0299-0312	29.0	1	10.7	3
0313-0326	38.0	2		
0327-0340			10.0	1
0341-0354*	20.0	1		
AVERAGES FROM ALL PREVIOUS TIME PERIODS				
0000-0340	22.7	12	17.4	19

REF# 26 DIST 1 2 3 4 5 8 9

Figure 4-4. (31E/44B): Average job completion time in days (Table 4, Ref. 26).

The source of information for the computations resulting in this table are the data recorded on the specially designed MPS-1 form. These data are in turn derived from Form DA 2407 which lists Julian date and time that the equipment is initially received from the customer and accepted by the DS shop. The completion time calculation for a single MPS-1 form is described in Supplement 1 to Appendix A of this volume. Note that for purposes of the calculation, a day is defined as 24 hours in length—6 hours, for example, will represent .25 days.

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TABLE 4 (41C/45B/45K/L): AVERAGE JOB COMPLETION TIME IN DAYS

REPORTING PERIOD ENDING: 0354* (19 DEC 80)

REPORTING INTERVAL JULIAN DATES	MOS 41C		MOS 45B		MOS 45K/L M60 FAMILY		MOS 45K/L M109		MOS 45K/L OTHER		AVG. DAYS 45K/L
	AVG. DAYS	NO. JOBS	AVG. DAYS	NO. JOBS	AVG. DAYS	NO. JOBS	AVG. DAYS	NO. JOBS	AVG. DAYS	NO. JOBS	JOBS
0187-0200					23.3	12	28.0	3			24.2
0201-0214	22.7	3	22.7	3	23.4	7	25.3	3			24.0
0215-0228	31.0	2	31.0	2	21.6	14	21.7	3			21.6
0229-0242					16.4	9	15.2	5	12.3	2	15.5
0243-0256	22.0	2	22.0	2	14.1	16	11.5	2			13.8
0257-0270					10.2	13	24.0	4			13.4
0271-0284					10.1	17	17.6	5	14.5	3	12.1
0285-0298	18.0	1	18.0	1	14.6	5	15.5	6	11.6	2	14.6
0299-0312	29.0	1	29.0	1	9.8	15	17.2	9			12.6
0313-0326	38.0	2	38.0	2	13.1	7	17.5	6			15.1
0327-0340					1.7	3	40.7				21.2
0341-0354*	20.0	1	20.0	1	14.4	7	27.3	3			18.3
AVERAGES FROM ALL PREVIOUS TIME PERIODS											
0000-0340	25.6	2	31.0	3	15.8	11	26.8	6	16.2	12	17.6

REF# 27 DIST 1 2 3 4 5 7

Figure 4-5. (41C/45B/45K/L): Average job completion time in days (Table 4, Ref. 27).

The time from start to finish of a job, i.e., completion time, is an overall measure of shop efficiency. The faster a job can be done, the more efficiently the shop is operating—providing quality is held constant. The average job completion times recorded do not account for the exact nature of jobs being performed. Job completion time includes that taken by all jobs of a given category. For example, *all C&E jobs, or all welding, and sheet metal jobs performed* in the time period reported on are combined. The assumption here is that differences in job complexity will average out across time.

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TABLE 4 (63H/W-TRACK): AVERAGE JOB COMPLETION TIME IN DAYS

REPORTING PERIOD ENDING: 0354* (19 DEC 80)

REPORTING INTERVAL JULIAN DATES	M60 FAM. AVG. DAYS	M60 FAM. NO. JOBS	M113 FAM. AVG. DAYS	M113 FAM. NO. JOBS	M109/578 AVG. DAYS	M109/578 NO. JOBS	M88 AVG. DAYS	M88 NO. JOBS	OTHER AVG. DAYS	OTHER NO. JOBS	AVG. DAYS ALL JOBS
0187-0200			28.0	4	23.3	12	28.0	3	23.3	12	24.4
0201-0214	22.7	3	32.0	1	23.4	7	25.3	3	23.4	7	24.0
0215-0228	31.0	2			21.6	14	21.7	3	21.6	14	22.2
0229-0242			24.0	2	16.4	9	15.2	5	16.4	9	16.8
0243-0256	22.0	2	22.0	2	14.1	16	11.5	2	14.1	16	14.8
0257-0270			61.3	3	10.2	13	24.0	4	10.2	13	16.5
0271-0284					10.1	17	17.6	5	10.1	17	11.1
0285-0298	18.0	1	12.3	3	14.6	5	15.5	6	14.6	5	14.7
0299-0312	29.0	1	10.7	3	9.8	15	17.2	9	9.8	15	11.9
0313-0326	38.0	2			13.1	7	17.5	6	13.1	7	16.6
0327-0340			10.0	1	1.7	3	40.7	3	1.7	3	14.2
0341-0354*	20.0	1			14.4	7	27.3	3	14.4	7	16.9
AVERAGES FROM ALL PREVIOUS TIME PERIODS											
0000-0340	22.7	2	25.6	2	18.5	10	23.4	7	13.4	3	19.7

REF# 29 DIST 1 2 3 4 5 6

Figure 4-6. (63H/W-TRACK): Average job completion time in days (Table 4, Ref. 29).

Three examples of Table 4 are provided. Figure 4-4 shows two MOS's, 31E and 44B. Figure 4-5 shows three MOS's--41C/45B, and 45K/L, together with a breakdown by equipment type for armament jobs. Figure 4-6 shows MOS's 63H/W together with a breakdown of major tracked equipment "families."

Note in the MOS 31E section of Figure 4-4 that the current time period shows a period of 20 days to complete one job. But the historical average (based on 12 jobs) shows 22.7 days as the average time for completion. The supervisor examining these data would assume no action is required since the current period is approximately the same as the historical average. However, on the previous time period (i.e., 0313-0326) note the average time taken was 38 days derived from a total of two jobs. In this instance, the supervisor should investigate the reason for the difference between the average period and that reported. Possible causes are: excessively long waiting times for parts; customers tardiness in bringing inspected work to the shop; or delay in customer pickup after work is completed.

Note also in the MOS 44B section in Figure 4-4 that the average completion time is 17.4 days per job derived from a total of 19 jobs. Yet in Julian date period 0257-0270 the average derived from a three-job total is 61.3 days. Here again the supervisor of the welding and sheet metal repairmen must investigate the reason for such an inordinately long completion time. Possible causes could include lack of parts, lack of resources, late pickup by customer, late drop-off by customer after initial inspection, continued rejection by customer or turnback by shop inspection, and lack of skill by repairmen. Examination of Figures 4-5 and 4-6 will show similar discrepancies which should serve as "flags" to the motivated supervisor.

Average Days Spent in Each Job Status—Table 5, Ref. 31

(See Figure 4-7 for example of Table 5.) The data in this table are somewhat similar to those in Table 4 (Job Completion Time) but are further broken down into these five job statuses:

JOB STATUS CODE	STATUS
A	Initial Inspection
C	Awaiting Shop
B	In Shop
K	Awaiting Parts
R	Awaiting Pickup

The statuses are almost identical to those described in the TAMMS manual (TM 38-750) but are defined in more detail below for convenience of the reader.

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TABLE 5 (31E/44B): AVERAGE DAYS SPENT IN EACH JOB STATUS FOR COMMUNICATION & ELECTRONICS AND WELDING JOBS

REPORTING PERIOD ENDING: 0354* (19 DEC 80)

DAYS IN EACH STATUS BY JOB TYPE

REPORTING INTERVAL JULIAN DATES	COMM. ELEC. JOBS (31E)					WELDING JOBS (44B)				
	A	K	C	B	R	A	K	C	B	R
0187-0200	1.0	1.3	3.4	2.9	2.2	2.3	47.1	19.2	0.5	0.4
0201-0214	0.4	2.3	1.5	3.7	4.4	4.3	26.8	5.0	1.5	1.5
0215-0228	0.0	0.6	5.2	3.6	2.0	4.1	30.7	8.1	0.6	3.
0229-0242	6.6	2.7	3.4	1.5	2.4	3.8	25.6	11.8	0.3	2.
0243-0256	0.4	2.5	2.9	8.6	1.2	2.1	25.8	21.4	0.2	1.2
0257-0270	0.2	2.6	4.8	4.4	3.1	3.5	29.3	19.5	1.9	1.
0271-0284	0.4	3.2	6.9	3.8	4.4	2.1	20.2	1.1	1.9	1.
0285-0298	0.4	4.7	5.4	4.4	4.4	2.8	16.8	17.5	1.4	0.5
0299-0312	0.4	2.7	3.7	4.0	4.1	5.2	15.5	7.4	0.7	1.7
0313-0326	6.0	1.8	12.7	2.6	3.4	16.9	7.0	14.6	0.1	1.
0327-0340	12.5	2.4	9.3	1.6	5.1	0.7	16.4	4.2	2.2	3.3
0341-0354*	1.0	2.2	6.6	39.4	9.7	2.5	7.7	3.0	0.4	1.8
AVERAGES FROM ALL PREVIOUS TIME PERIODS										
0000-0340	2.5	2.4	5.7	4.4	3.5	4.0	24.6	12.9	1.1	1.7

REF# 31 DIST 1 2 3 4 5 8 9

Figure 4-7. (31E/44B): Average days spent in each job status for communication and electronics and welding jobs (Table 5, Ref. 31).

Initial Inspection (A) represents the time elapsing between customer submission of DA Form 2407 and the time noted by the DS shop inspector when he returns the 2407 to the shop clerk. This elapsed time will include delays that may result from shop clerk actions or while waiting inspection. The measure is calculated from data recorded on the MPS-1 form to show the difference from the time a job is received to the time it moves to the next job status. This elapsed time interval is averaged for all jobs in each equipment category.

Awaiting Parts (K) refers to the interval between the time a job enters the awaiting parts status to the time it enters the next status. This interval can indicate how work flow is being affected by supply. It is similar to NORS, but NORS is much more broadly defined. "K" status as used in the MPS is an overall indicator of the effect of parts supply on maintenance job completion. The computation of this element of the table is similar to that for "A" status.

Awaiting Shop (C) refers to the interval between the time a job is ready to be worked on but cannot enter the shop because of lack of bays, work space, etc., to the time it enters the next status.

In-Shop (C) refers to the interval between the time equipment enters the shop to the time it leaves the shop, i.e., enters "R" status. (Note that this interval includes time required for final inspection. This liberal interpretation of "in shop" is used since final inspection time is often not available as a separate status.)

Awaiting Pick-up (R) is defined as the time elapsed from when the shop office clerks notify the customer to pick up repaired equipment, to the time the customer actually accepts and removes the vehicle.

The data in this table follow the same format as in other tables, i.e., data for the most recent two-week (i.e., current) reporting period is shown at the second bottom line marked with an asterisk, and the averages from all previous time periods for each status is shown on the bottom line. The Figure 4-7 example shows data for jobs done by MOS 31E (Field Radio Repairman) and 44B (Sheet Metal Worker).

Maintenance managers can monitor the MOS-specific totals shown in each status column to find out how long work takes to move through each status. Backlog and bottlenecks in maintenance work flow are easily noted if they deviate radically from the averaged figures.

A bottleneck in **"A" status** means there is a problem getting work processed into the shop. Paperwork may be delayed in the shop office, inspectors may be too slow, the inspection section may be understaffed, scheduling of inspections may be

inefficient, or there may be poor organizational level maintenance whereby jobs are returned because of noncompletion of such preparatory maintenance which is properly the customer's responsibility.

A bottleneck in **"K" status** means there is a problem with supply. Parts may not be ordered properly, inaccuracies on the requisition will result in deliveries of the wrong parts, there may be true non-availability of the supply items ordered causing extensive delay, or parts may even be received centrally but not picked up in timely fashion by the DS unit.

A bottleneck in **"C" status** means the shop has more work than it can handle. The workload may be higher than normal, there may be too few repairmen in the shop to handle the work, skill level of the repairmen may require improvement, work bays may not be available, or poor scheduling problems of those bays which are available may all contribute to delay.

A bottleneck in **"B" status** means that once work is in the shop it is not moving through the shop rapidly enough. Again, the reasons are interlocked with other statuses that may stem from heavy workload, insufficient resources, lack of TM's or reference material, poor shop management, or even delays in conducting final inspections on completed work.

A bottleneck in **"R" status** means that customers are not picking up their finished work quickly. The delay from the DS point of view is that parking space and shop floor space may be taken up by finished jobs and cause delays in "C" status.

These bottlenecks should be considered as indicators that signal the existence of a problem. Possible solutions may depend on courses of action beyond the capability of the maintenance manager. If the DS shop for example, is short staffed, the maintenance manager may request additional repairmen but must still depend on the availability of staff in the personnel supply pipeline. If the skill of his repairmen is below his needs or expectations, he may have to seek specialized help to have his men trained. Training and its relationship to maintenance via the MPS is discussed in the remainder of this chapter.

TRAINING MANAGEMENT REPORTS

MPS Tables six through nine are primarily oriented to training. Though the information they provide may also be useful for logistics and resource management, the prime emphasis behind the design of these tables and the thrust of their content is on providing training information.

The training information in MPS reports will:

- provide indicators of specific training requirements for each individual in the MOS's being tracked
- specify the tasks and equipments for which training is required
- maintain a skill proficiency profile for each man which is updated as his experience and training increase
- provide comparative figures on relative skill levels among various MOS's
- specify the training resources and reference sources needed to conduct training.

Each table is described in detail below.

A more detailed description of the application of these tables for the training manager and trainer in the direct support company is contained in the **Guide for individual technical training in direct support units.**[6]

Skill and Growth Indexes—Table 6, Ref. 38

(See Figure 4-8 for example of Table 6.) Although only seven names are shown as an example of the data to be provided on this table, the table represents data for a high density MOS. The table shows skill and growth indexes numerically and graphically for not only each individual repairman, but for all repairmen contained within a specific paygrade category as a group. The dashed vertical line on the graph represents the average skill index for all holders of the MOS.

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[6] Simpson, H. K., & Fuller, R. G. **Guide for individual technical training in direct support units. Volume 1: training methodology.** Santa Barbara, California: Anacapa Sciences, Inc., December 1980.

The basic constituent of the summarized data shown in Figure 4-8 is derived from the task experience history (MPS 6) completed by each repairman. Added to this history are credits accrued from training, performance of work in the field, or by on-the-job exposure (OJE). The cumulative total represents each man's skill index. In other words, it is an up-to-date record of his standing on the composite skill level for all technical tasks in his MOS.

The growth index is another important component of this table. The growth index represents the amount of increase in skill as measured on subjective indices of exposure, training, and performance combined to represent his technical growth

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TABLE 6 (63H/W): SKILL AND GROWTH INDEXES

REPORTING PERIOD ENDING: 0284 (10 OCT 80)

NAME MOS-PAYGRADE	SKILL INDEX	GROWTH INDEX	SKILL INDEX 0----------50----------100
ALL E1/2	42	5.2	----------+
ALL E3	50	12.9	----------+
ALL E4	55	1.8	----------+
ALL E5	61	0.0	----------
ALL E1-E5	49	4.6	----------+
MOOSIE(63H-E5)	61	0.0	----------‡---
SPIEGELMAN(63H-E4)	57	0.0	----------‡--
FULLER(63W-E4)	52	3.6	----------‡-+
ZIMMERMANN(63H-E3)	50	12.9	----------‡+
SIMPSON(63H-E1)	50	12.9	----------‡+
HARPER(63W-E2)	48	2.9	----------‡
NORRIS(63W-E2)	27	0.0	-------- ‡

+ SKILL GROWTH DURING LAST 6 WEEKS

REF# 38 DIST 1 3 5 6

Figure 4-8. (63H/W): Skill and growth indexes (Table 6, Ref. 38).

during the period under review (a base of 100 is used for presentation). This table is updated every six weeks instead of the two-week interval used for Tables 1 through 5 because of the slow rate of change on individuals' records that one can expect when training and skill acquisition are infrequent.

The skill index is calculated by summing the number of times a repairman has performed task 1, task 2, and so on as listed for equipment maintained by his MOS, and then dividing this total by the number of jobs multiplied by seven. Senior personnel consider that after a man has done a job seven times, no marked improvement will show in his skill level. The number of credits for each job has therefore been subjectively set at seven.

In general, low skill indexes indicate lack of skill. Low growth indexes indicate lack of experience and training to develop skills during a current reporting period. Skill indexes are calculated so that a score of about 70 (on a base of 100) represents an average and adequate skill level for a typical group of soldiers. Experienced personnel will have higher scores. Newly assigned repairmen, who typically need the most training, will have lower scores. From records kept over the past 18 months, we estimate the growth index for repairmen in a typical technical MOS should average three percent. Since inexperienced soldiers have more to learn, their growth index should obviously be higher. Soldiers with low skill indexes should have growth indexes nearer five percent. Conversely, soldiers with skill indexes above 50 percent should have growth indexes near two percent. Table 6 (Figure 4-8) is useful to those concerned with training to help determine how serious the training problem is for members of a specific MOS within the unit. The growth index columns will also provide a yardstick to evaluate the effectiveness of any training solutions. By observing whether or not the skill indexes and growth indexes change during several time periods, one can assess whether training is actually taking place, and whether it is being credited to individuals.

In summary, low growth indexes indicate training is not happening or is not effective. Low skill indexes indicate serious training deficiencies. Skill indexes should rise in parallel with the amount of training conducted. If they do not, training is not effective.

Skill Development Summary—Table 7, Ref. 40

(See Figure 4-9 for an example of Table 7.) The information contained in this table is an important tool for training managers and senior officers concerned with the skill levels of battalion personnel. The table contains six major components in columnar form. MOS groups are listed with the average skill index shown for each MOS group related to a base of 100. In addition, the growth index subcomponents are shown by exposure, training, and demonstrated performance. A summed column of these three components is shown as a total growth index. This table represents an overview at the battalion level of skill and growth, similar to the data shown in Table 6 (Figure 4-8) for repairmen in individual MOS's.

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TABLE 7 : SKILL DEVELOPMENT SUMMARY

REPORTING PERIOD ENDING: 0354 (19 DEC 80)

MOS	AVERAGE SKILL INDEX	GROWTH INDEX COMPONENTS			TOTAL GROWTH INDEX
		EXPOSURE INDEX	TRAINING INDEX	PERFORMANCE INDEX	
31E	40	1.4	3.5	4.0	8.9
41C	35	4.8	4.4	2.1	11.3
44B	62	1.0	2.0	1.4	4.4
45B	70	1.5	2.0	1.4	4.4
45K/L	56	2.6	1.7	1.6	5.9
52D	36	4.8	4.0	3.0	11.8
63G	68	2.3	1.3	1.4	5.0
63H/W	75	1.2	1.0	2.1	4.3

REF# 40 DIST 1 3 5 6 8 9

Figure 4-9. Skill development summary (Table 7, Ref. 40).

Examination of Figure 4-9 will show the disparity among "average skill index" column figures for each MOS group. Note for example that MOS 63H/W has an average skill index of 75. The lowest group is MOS 41C with an average skill index of 35. This would suggest to the commander that emphasis needs to be placed on training for MOS 41C members. The figure of 11.3 in the Total Growth Index column for MOS 41C indicates that action has already been taken in the last reporting period to improve the skill levels of 41C members. Note the relatively high exposure index figure of 4.8 for the 41C, matched only by a figure of 4.8 for MOS 52D (an MOS whose members also show a disturbingly low skill index). The training index figures for the 41C are the highest which indicates that emphasis has been placed on training as a means of upgrading skills and that it has taken place during the preceding six-week period.

These relative indexes are important management tools. If exposure index is low the supervisors are not exposing the repairmen to new jobs. If the training index is low then repairmen are receiving no training. If performance index is low then supervisors are not providing opportunities for repairmen to demonstrate their ability. The value of this table as a management tool is high since it bridges the gap between shop performance, exposure to tasks and training. Those senior officers with responsibilities in both areas will probably be the prime users of this table.

Individual Skill History—Table 8, Ref. 48

(See Figure 4-10 for example of Table 8.) Each repairman in the direct support company whose MOS is being tracked by the MPS will receive a copy of this table. It shows his skill credit standing listed by specific tasks on equipment items. The table will be provided to the training managers and repairmen every six weeks.

The information is computed from data recorded on the MPS-6—Repairman's Task Experience history, the MPS-5—Training/Performance Demonstration form, and the MPS-2—Job/Task Performance form.

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TABLE 8 (63H/W): INDIVIDUAL SKILL HISTORY

NAME: SIMPSON(63H-E1)

REPORTING PERIOD ENDING: 0284 (10 OCT 80)

	NUMBER OF CREDITS						
EQUIPMENT/TASK	1	2	3	4	5	6	7
M60 FAMILY							
1 REPL ENG/TRANS	*	*	*	+			
2 REPL FUEL INJ NOZZLE	*	*	*	+			
3 REPL FUEL INJ PUMP	*	*	*	+			
4 REPL FUEL TANK	*	*	*	+			
5 REPL TURBOCHARGER	*	*	*				
M113 FAMILY							
1 REPL ENG/TRANS/TRANSF	*						
2 REPL CYL HEAD	*						
3 REPL FUEL INJ NOZZLE	*						
4 ADJ FUEL INJ RACK CONTR	*						
5 ADJ GOVERNOR	*						
6 REPL ENG AIR BLOWER	*						
M109/M578							
1 REPL ENG/TRANS/TRANSF	*	*	*	*	*	*	+
2 REPL CYL HEAD	*	*	*	*	*	*	*
3 REPL FUEL INJ NOZZLE	*	*	*	*	*	*	*
4 ADJ FUEL INJ RACK CONTR	*	*	*	*	*	*	+
5 REPL TURBOCHARGER	*						
6 REPL GOVERNOR	*						
M88A1							
1 REPL ENG/TRANS	*	+	+	+	+	+	+
2 REPL TURBOSUPERCHARGER	*	+	+	+	+	+	+
3 REPL TRANS OIL COOLER	*						

REF# 48 DIST 6 11

Figure 4-10. (63H/W): Individual skill history (Table 8, Ref. 48).

Table 8 (Figure 4-10) identifies each man by name, primary MOS, and paygrade. It also notes the reporting period end date. Tasks specific to each equipment (or family of equipment) are shown on the left column. On the right side, the number of credits is shown on a scale ranging from 1 to 7. A cross symbol (+) indicates that the repairman has gained credit from either job exposure, training, or has demonstrated acceptable performance of the task.

The primary value of this type of report is as a skill record and graphic indicator of a repairman's standing on all his required technical tasks. It is not designed to be a predictor of training needs or an indicator of training resources. These latter two requirements are met by other MPS tables (e.g., Tables 6, 7 and 9).

In the example, repairman Simpson, an E1 holding MOS 63H, is shown as having adequate experience on Tasks 1 through 4 on the M109/M578 equipment. But he has still much to learn on Tasks 5 and 6 (shown with only one skill credit for each task). He has somewhat more experience on the M60 tank group and has reached about 50 percent of his required credit total. On the M113 family of equipment, he has minimal experience.

Note the crosses (+) on the M88A1 entry. These could signify that Simpson has had intensive training during the last six weeks or has had much job exposure, or has demonstrated he is completely capable of performing the task unsupervised.

The impact of the table for the trainer shows Simpson as a prime candidate for training on the M113 as a first priority and on the M60 as a second priority. Training or exposure to repair tasks on the M109 and M881 may be deferred to some convenient later time period. From the repairman's point of view, Table 8 indicates his standing on the tasks he is expected to know to fulfill his soldier's manual requirements for SQTs. Table 8 also helps identify the unit's expectation of what repairmen must be able to do to be efficient members of the shop workforce. If the man is motivated enough by realization of the career effect of the data in Table 8, he can request additional training via self-training, or formally structured training methods, to improve his standing on low credit tasks.

Note the unorthodox MOS designator (63H/W) in the header of Table 8. The special explanatory note which follows is included at this point for clarification.

SPECIAL NOTE ON MOS 63H/W INTEGRATION RELATED TO MPS

Prior to 1 October 1980, MOS 63H included repairmen with skills in automotive repairs of both tracked and wheeled vehicles at the DS/GS level. The basic skills to conduct these repairs was learned during AIT at USAOC&S. The man's skill was subsequently enhanced by being able to work on a selection of wheeled and tracked vehicles in direct support units.

As part of the career management field reorganization that took effect 1 October 1980, CMF 63 included two new specialties--63H, dealing with tracked vehicle repairs; and 63W, dealing with wheeled vehicle repairs. The MPS was designed around the formal job responsibilities of these two MOS's. Equipment and task lists in the MPS were compiled to conform to the new work assignments of these MOS's.

Unfortunately, the effects of the career field split will not be apparent on the shop floor for many months. An even longer time may pass before new MOS graduates from AIT are available and fully integrated into operational units. From interviews in CONUS and USAREUR, we found that although all existing MOS 63H repairmen were required to be reclassified into a 63H or 63W category, work arrangements on the shop floor have not changed. That is, the first automotive repairman available works on the next automotive job in the sequence, regardless of whether it is tracked or wheeled. Senior officers controlling DS maintenance feel they must use all available skills in the existing technical manpower pool to cope with the workload. They feel they cannot indulge the luxury of having 63W specialists wait for wheeled work while a tracked vehicle is deadlined for lack of repair staff.

We have modified the MPS on a temporary basis to conform to these current operational conditions. Tables, headings, and in some cases, algorithms, have been modified to show combined totals for 63H/W MOS's. The effect on MPS tables is listed below.

- Table 1 (Man-Hour Availability and Use) will show these data as a combined 63H/W total.
- Table 2 (Average Direct Man-Hours Per Job) will not change since tracked data and wheeled data have always been reported separately.
- Table 3 (Average Direct Man-Hours Per Job by Equipment and Task) has been combined to show MOS 63H/W computed data. The net effect of this change is that repairmen will be credited with man-hours they spend doing either wheeled tasks or tracked tasks, regardless of their reclassified MOS.
- Table 4 (Average Job Completion Time in Days) will require no change since tracked and wheeled data have always been reported separately.
- Table 5 (Average Days Spent in Each Status for Wheel and Truck Jobs) has always been shown as a combined 63H/W total.
- Table 6 (Skill and Growth Indexes) will show a combined index for 63H/W MOS.
- Table 7 (Skill Development Summary) will show MOS's 63H and 63W combined.
- Table 8 (Individual Skill History) will be shown as a combined task inventory for both 63H/W tasks.
- Table 9 (Training Requirements Summary) will combine training tasks for both MOS's into a combined 63H/W.

If and when the career split into 63H and 63W becomes operationally effective enough to warrant separate tables for each speciality, the MPS is already pre-programmed to provide such tables with a minimum of modification.

Training Requirements Summary—Table 9, Ref. 57

(See Figure 4-11 for example of Table 9.) Table 9 has been specially developed to indicate to unit training managers and trainers what job exposure is needed, what training needs to be developed, and what personnel require the training. Figure 4-11 shows an example of this table.

This table contains a wealth of information cross-indexed on various topics. It is MOS-specific and is developed each six weeks for each MOS being tracked by the MPS. Under the table title a **threshold** figure is listed. This threshold figure is selected from a range of 1-7 on a subjective basis by the training manager/trainer so that a manageable number of training requirements will appear on the table. If the threshold is set very low (number 1 on the scale is highest), say at 6 or 7, most

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TABLE 9 (63H/W): TRAINING REQUIREMENTS SUMMARY

THRESHOLD: 2

REPORTING PERIOD ENDING: 0284 (10 OCT 80)

PRIO-RITY	NAMES	EQUIPMENT/TASKS	TRNG. REF.
		M60 FAMILY	

1	MOOSIE(63H-E5) NORRIS(63W-E2)	2 REPL FUEL INJ NOZZLE	B79/81
1	HARPER(63J-E2) NORRIS(63W-E2)	4 REPL FUEL TANK	B79/81
1	HARPER(63J-E2) NORRIS(63W-E2) ZIMMERMANN(62D-E3)	5 REPL TURBOCHARGER	B79/82
2	NORRIS(63W-E2)	1 REPL ENG/TRANS	B79/81
S2	NORRIS(63W-E2)	3 REPL FUEL INJ PUMP	B79/81
		M113 FAMILY	

1	FULLER(52D-E4) NORRIS(63W-E2) SIMPSON(63H-E1) ZIMMERMANN(62D-E3)	4 ADJ FUEL INJ RACK CONTR	B79/83
1	FULLER(52D-E4) HARPER(63J-E2) NORRIS(63W-E2) SIMPSON(63H-E1) ZIMMERMANN(62D-E3)	5 ADJ GOVERNOR	B79/83
1	HARPER(63J-E2) NORRIS(63W-E2) SIMPSON(63H-E1) ZIMMERMANN(62D-E3)	6 REPL ENG AIR BLOWER	B79/83
		M109/M578	

1	MOOSIE(63H-E5) NORRIS(63W-E2)	2 REPL CYL HEAD	B80/83
REF# 57	DIST	5 6	

Figure 4-11. (63H/W): Training requirements summary (Table 9, Ref. 57).

or all tasks will appear on Table 9 as training requirements. These would include requirements for training on tasks that are performed say, only once per year on a single piece of equipment. Conversely, higher thresholds will direct the computer to list training requirements in a more parsimonious fashion. For practical use, the threshold should normally be set between numbers 1 and 3.

The first column on the left of the table is titled **priority**. This represents an estimate of importance shown on a scale ranging from 1 to 7 (1 being high) indicating the relative importance of a particular training requirement. It is computed by an algorithm that considers both the average skill index and the number of personnel needing training on each task. Note in the example that the priority 1 designator has been assigned to Tasks 2, 4, and 5 for the M60 equipment. But **priority 2** is assigned to Task 1 for the M60.

The table also lists under **names** those personnel who require training to meet requirements of their primary MOS designator and paygrade, and to meet the maintenance managers' needs for skilled personnel.

For the **equipment/task** column, the table is organized vertically so the closer an equipment is placed to the top of the listing, the higher the priority that is required for training on this equipment and related repair tasks.

The general rule for listing tasks is that only tasks with priorities at, or above, threshold are shown on the printout. This rule is waived if a **special priority flag** marks the task. All special priority tasks are listed, since they override computed priorities. A special priority listing (shown by an "S" symbol) indicates that a commander or training manager has designated the task as especially important. In effect, it means that the commander or training manager has overridden the computer's assessment of priority to attach his own higher priority rating.

The extreme right-hand column of Table 9 includes the **training reference**. The reference number in this column keys the user to a page number in the MPS guide to individual training (see Reference 1) which contains detailed training resource information. Not only will the training reference resource page number

identify the location of a description of the key steps used in performing a task, but it will also provide information on training resources specifically arranged by task and equipment.

This table is the single most important record in the DS unit training manager/trainer's inventory of training information related to repairmen. It is an objective record of training requirements listed by task, equipment, and priority, for each man according to his performance in the previous six weeks. The computer will maintain this history and update it as each task is performed, training is received, or performance is demonstrated.

Interpretation of the table must still take place. It cannot be left to the computer-based assessment alone. The training manager, for example, may know of local conditions which affect the conduct of training which the computer cannot consider. Inspections, accounting, inventory checks, special weather conditions, and lack of equipment on which the training is needed are examples of information that will affect interpretation of Table 9.

Conversely, the training manager may have additional information that will require him to override the recommendation for low priority of training set by the computer. For example, the DS unit may have to support special exercise requirements whereby customer battalions want all of their vehicles or equipment in a certain category overhauled in three days or a similar short period. The most common example of such an influx of work is when a customer unit requests all MOS 45K turret jobs completed immediately prior to moving M60 tanks down range for gunnery exercises.

APPENDIX A
NOTES ON DATA COMPUTATION AND REPORT GENERATION

ESTIMATED DATA REQUIREMENTS (shown as MPS form entries per week)

Table A-1 summarizes the relationships among reports and MPS data input forms and shows the number of forms that are estimated to need entering each week for a single company. Note that reports will be generated from a complex file structure only generally described here. The files will be developed initially from data entered from the listed MPS forms. Reports will be generated from the files, not directly from the ASF forms.

TABLE A-1

INITIAL DATA SOURCES (FORMS) FOR EACH REPORT AND NUMBER OF FORMS ESTIMATED PER WEEK

REPORT REFERENCE NUMBER	MPS FORM NUMBER								
	1	2	3	4	5	6	7	8	9
1				X		X			
2								X	
3-11			X	X					
12-16		X							
17-25		X					X		
26-30	X								
31-35	X								
36-39		X		X	X	X			
40		X		X	X	X			
41-49		X		X	X	X			
50-58		X		X	X	X	X		X
NUMBER OF FORMS/WEEK	100	100	50	1*	25	5*	1	1	1

*Up to 75 during MPS start-up.

ROSTER

The roster will be generated from MPS-4 and MPS-6 file data.

The roster will have nine sections—one for each MOS. (Note that MOS's 45K and 45L are combined into the 45K/L category. MOS's 63H and 63W are also combined as 63H/W on a temporary basis.) Within each MOS section, personnel will be listed alphabetically in the ASSIGNED or DELETED portion.

A CODE number is listed beside each name.

An "N" will appear opposite the name in the HIST column if no MPS-6 has been entered for the repairman; otherwise, there will be a blank.

The roster will show when a repairman "legally" worked in the MOS. He will become part of the work force on his START DATE and will stop working in the MOS on his STOP DATE.

Names of personnel who are shown "deleted" on an MPS-4 will move from the ASSIGNED to DELETED category and show a STOP DATE. These names will continue to be listed (until file compression occurs) with their stop date, more than six weeks earlier than the closing date on the file compression. The roster record will then be purged of the "deleted" names. Other related individual operator records (e.g., MPS-6-based individual task experience history) will also be purged at that time.

If a repairman is deleted in error, he can be RE-ADDed (changed from DELETED to ASSIGNED status) with an MPS-4 entry up to the date when his records would be purged from the roster.

INTERPRETATION COMMENTS

Interpretation Comments will be generated based on MPS-8 file data.

Up to three sets of comments can be displayed for each 14-day reporting interval. Each comment line may be up to 128 characters in length.

Table 1 (Man-Hour Availability and Use)

Table 1 will be generated from MPS-3 and MPS-4 file data.

ASSIGNED MAN-HOURS will be calculated from MPS-4-based roster data. For a given MOS, the program must access the roster file to determine the number of repairmen working in a specific MOS (both ASSIGNED and DELETED) on each of the five working days (Monday-Friday)[1] of each week covered. ASSIGNED MAN-HOURS for this interval will be calculated by multiplying the number of repairmen per day by eight hours per repairman per day and summing this over the 10 working days of the interval. In algorithmic form:

$$\text{ASSIGNED MAN-HOURS} = \sum_{\text{time}=0}^{\text{time}=10\text{ working days}} \left(\begin{array}{c}\text{Number of}\\ \text{men assigned}\\ \text{per day}\end{array}\right) \times \left(\begin{array}{c}\text{8 hours}\\ \text{per man}\\ \text{per day}\end{array}\right)$$

AVAILABLE, DIRECT, AND OVERTIME man-hours will be calculated from MPS-3 file data. The quantities shown will be the sums of those hours appearing on *all MPS-3's for the MOS during each reporting interval.* This is represented symbolically by:

$$\text{AVAILABLE MAN-HOURS} = \sum_{\text{time}=0}^{\text{time}=10\text{ working days}} \sum_{\text{man 1}}^{\text{man n}} \left(\begin{array}{c}\text{Number of man-hours}\\ \text{per man per day}\end{array}\right)$$

The two right-hand columns (PERCENT AVAIL/ASSIGNED MAN-HRS and PERCENT DIRECT/AVAIL MAN-HRS) will contain ratios based on the ASSIGNED, AVAILABLE, and DIRECT man-hours shown in the columns on the same row in the table.

---

[1] Every weekday is counted; holidays are not recognized in the computation. However, a "comment" may be added for interpretation if holidays were worked and classified as overtime.

Table 2 (Average Direct Man-Hours per Job)

Table 2 will be based on MPS-2 file data.

The various Tables 2 differ somewhat in format and appearance. Differences are based on equipment sub-category and MOS.

Each MPS-2 will represent one job performance by a particular MOS. The number of hours required to perform the job will be the sum of the man-hours listed in the MPS-2. The AVG HOURS total shown on Table 2 is the average of the number of hours for all of the MPS-2's submitted in that period for the particular MOS and equipment sub-category:

$$\text{AVERAGE HOURS} = \frac{\sum_{\text{first MPS-2}}^{\text{last MPS-2}} \text{Number of direct man-hours per MPS-2 job}}{\text{total number of MPS-2's}}$$

The NO. OF JOBS entry is equivalent to the number of MPS-2's used in making the calculation.

Table 3 (Average Direct Man-Hours per Job by Equipment and Task)

Table 3 is based on MPS-2 and MPS-7 file data.

Table 3 may be considered an extension of Table 2, with average man-hours shown by individual task. However, MAN-HOURS PER TASK can only be calculated from single-task MPS-2's. That is, if an MPS-2 is entered representing more than one task, that MPS-2 may be used to generate Table 2, but not Table 3. The MPS cannot apportion hours to tasks within an aggregate unless each task is specified by time taken.

The CURRENT AVG. is the average number of man-hours for performing the indicated task on those MPS-2's representing that task. The NO. OF JOBS is equivalent to the number of MPS-2's used in making the above calculation.

The AVG FROM PREV. PERIODS is the average number of hours for performing the indicated task listed on MPS-2's (representing that task) more than two weeks old. The NO OF JOBS shown with the previous period average is the same as the number of MPS-2's used in making the above calculation.

Table 3 is also used as a convenient vehicle to display a SPECIAL PRIORITY "FLAG" in a separate column. An "S" will appear opposite any task that was given a SPECIAL PRIORITY FLAG based on information from an MPS-7. An "N" will appear if a task was given a NULL flag. Otherwise, the column will be blank.

Table 4 (Average Job Completion Time in Days)

Table 4 is based upon MPS-1 file data.

The various Table 4's will differ somewhat in format and appearance. Differences are based on job sub-category and MOS.

The COMPLETION time calculation for a single MPS-1 is described in Supplement 1 to this Appendix. Note that for purpcses of these calculations a day is defined as 24 hours in length; 6 hours, for example, represents .25 days. To arrive at the AVG. DAYS shown in Table 4, the completion time must be summed for all of the MPS-1's for a particular MOS and equipment sub-category. This is symbolized as follows:

$$\text{AVERAGE DAYS (Completion time)} = \frac{\sum_{\text{first MPS-1}}^{\text{last MPS-1}} \text{Completion-time days per MPS-1 job}}{\text{total number of MPS-1's}}$$

The NO. OF JOBS entry will be equivalent to the number of MPS-1's used in making the calculation.

Table 5 (Average Days Spent in Each Job Status for Communication and Electronic Welding Jobs)

Table 5 will be based upon MPS-1 file data.

The various Table 5's will differ somewhat in format and appearance. Differences are based on job sub-category and MOS.

Calculation of the "A," "K," "C," "B," AND "R" time intervals for a single MPS-1 is described in Supplement 1. These intervals will be summed for all of the MPS-1's for a particular MOS and equipment sub-category (see Table 4 discussion of AVG DAYS Completion time).

Table 6 (Skill and Growth Indexes)

Table 6 is based upon file data generated from MPS-2, MPS-4, MPS-5, and MPS-6.

Once a repairman is added to the roster from data on an MPS-4 and assigned a code number, the MPS will generate a file for him.

Given a code number, an MPS-6 Job History can be entered into the computer for the repairman. The MPS-6 essentially lists the number of times he claims to have performed each of the tasks specific to his MOS.

Each time the repairman performs a task, it will be recorded on an MPS-2. Thus, the number of times a repairman has performed each task can be determined subsequently by adding the number of task performances shown on the MPS-6 to the additional task performances shown on MPS-2's.

The MPS-5 data (similar in concept to data on experience from the MPS-2) shows the number of "credits" a repairman may gain for additional performance of a task. By use of an MPS-5, a repairman will be recorded as receiving additional credits for training on a task, or for passing a performance test on it. The units of task experience (from MPS-2 and MPS-6) are different from those of training or performance (from MPS-5), but they are summed along a common scale.

A man's task experience profile will appear on Table 6 (shown as Skill Index) if he was listed on the roster as ASSIGNED on the closing date of the reporting interval.

SKILL INDEX will reflect the total experience, training, and performance test credits a man has accumulated for all tasks in his MOS. If a man performs a task twice (noted on MPS-6 and MPS-2) and receives training credit of 2 (from MPS-5), then his total skill credit for the task will be 4. The maximum credit he can receive for any task is 7. He is credited with this number if he receives performance test credit for the task (from MPS-5). The rationale here is that after a man has received a credit of 7 he will have adequate mastery of the task and will have reached an acceptable level of performance.

Total skill credit is the sum of all skill credits on all tasks for a specific MOS. SKILL INDEX is calculated by dividing total skill credit by the total number of MOS tasks multiplied by 7 (multiplied by 100 for scaling). This can be expressed mathematically by the expression:

$$\text{SKILL INDEX } (I_s) = \frac{\sum_{\text{first MOS task}}^{\text{last MOS task}} \text{Skill credits per task}}{\text{number of tasks} \times 7} \times 100$$

GROWTH INDEX is the difference between the current Skill Index for the man and the Skill Index computed six weeks earlier:

$$\text{Growth Index} = I_g \text{ (current)} - I_g \text{ (old)}$$

The line extending to the right on the scale of Table 6 shows Skill Index graphically. A "+" is shown at the end of this line if the Growth Index is greater than 5.

Note that Table 6 for low density MOS's (e.g., 31E) does not provide such detailed information as does Table 6 for high density MOS's (e.g., 63H/W). These higher-density MOS's provide enough data to generate valid averages. Individual Skill and Growth Indexes are shown on both high and low density MOS tables.

However, high density MOS tables show additional breakdowns of Skill and Growth Indexes for five paygrade sub-categories. These Skill and Growth Indexes are the averages for all personnel within the indicated paygrades. The average Skill Index for all paygrades (ALL E1-E5) is also shown graphically as a vertical dashed line.

Table 7 (Skill Development Summary)

Table 7 will be developed from the same information as Table 6. AVERAGE SKILL INDEX and TOTAL GROWTH INDEX will be calculated as described above. (These values are repeated from Table 6 and need not be re-calculated.)

As noted, Growth Index will be calculated based on credits given for job experience (from MPS-2 and MPS-6) and from training and testing (MPS-5).

EXPOSURE INDEX will be calculated in the same manner as Growth Index, but will use only experience credits from MPS-2.

TRAINING INDEX will be calculated in the same manner as Growth Index, but will use only training credits from MPS-5.

PERFORMANCE INDEX is similarly calculated, but will use performance testing credits from MPS-5.

Table 8 (Individual Skill History)

Table 8 will be based on the same information as Table 6.

This table will be generated for each repairman who was listed as ASSIGNED on the roster on the closing date of the reporting interval. A sequence of tables will be generated alphabetically (by name) within each MOS category.

Table 8 will show the total number of credits (experience, training, performance testing) each repairman holds for each task in his duty MOS on the report closing date. The NUMBER OF CREDITS scale ranges from 1 through 7; 7 is the maximum number of credits a man can hold for any task (see discussion in Chapter 6). A symbol (+) on a task line indicates a credit gained during the last reporting period.

Table 9 (Training Requirements Summary)

Table 9 will be generated from the same information used to generate Table 6, and will also use data from MPS-7 and MPS-9.

The Table 9 generation program will therefore:

1. Tally the skill credits on each MOS task in a given MOS for repairmen who have skill credits equal to or less than the skill credit THRESHOLD (entered from MPS-9).

2. Transform the tallies to a PRIORITY ranking (see Supplement 2).

3. List all tasks whose priority is equal to, or higher than, threshold level, and also those tasks to which a SPECIAL PRIORITY FLAG was attached. Tasks with a NULL Special Priority Flag will not be listed, regardless of the priority computed for them (see Supplement 2). Tasks will be ranked in order of priority within each equipment/job category.

4. Display PRIORITY in the PRIORITY column; and will display an adjacent symbol (S) if a Special Priority Flag is attached to the task.

5. List in the NAMES column all personnel whose task skill credit is equal to or less than threshold.

6. Retrieve the appropriate TRAINING REFERENCE NUMBER code from a pre-programmed matrix and list it in the TRAINING REFERENCE NUMBER column.

SUPPLEMENT 1

NOTES ON MPS-1 TIME INTERVALS USED TO CALCULATE ELAPSED TIMES IN "A," "K," "C," "B," AND "R" STATUSES AND "COMPLETION" TIME

GENERAL NOTES:

1. If ∅ appears on any line, an interval cannot be calculated between that line and another line.

2. If difference between any two lines is ∅, the ∅ will not count in averages using that interval.

SPECIFIC INTERVAL CALCULATIONS

NOTE: All line numbers refer to "MPS-1 JOB ORDER STATUS" form.

1. **"Delay" Time** - Time interval elapsing between when equipment due at shop and availability of equipment in shop.

   - Delay Time (DT) = L5 - L4
   - If L4 = ∅ or if L5 = ∅ then DT = ∅
   - If L5 - L4 ≤ ∅ then DT = ∅

2. **"A" Status Elapsed Time** - Time interval elapsing between receipt of DA Form 2407 at DSU and end of inspection, less delay time. End of inspection is indicated by transition from "A" Status to "K" or "M" (line 6), "C" (line 7), or "B" (line 8). (See Note 1.)

   - "A" Elapsed Time (AET) = L6 - L3 - DT
   - If L6 = ∅ then AET = L7 - L3 - DT
   - If L7 = ∅ then AET = L8 - L3 - DT

3. **"K" Status Elapsed Time** - Time interval(s) elapsing between entry to "K" status and transition to next status (may occur twice during single job). (See Note 1.)

   "K" Elapsed Time (KET) = K1 + K2

   - K1 = L7 - L6
   - If L7 = ∅ then K1 = L8 - L6
   - K2 = L10 - L9
   - If L10 = ∅ then K2 = L11 - L9

4. **"C" Status Elapsed Time** - Time interval(s) elapsing between entry to "C" status and transition to "B" status. (See Note 1.)

   "C" Elapsed Time (CET) = C1 + C2

   - C1 = L8 - L7
   - C2 = L11 - L10

5. **"B" Status Elapsed Time** - Time interval elapsing between entry to "B" status and transition to next status (includes "E" status). (See Note 1.)

   "B" Elapsed Time (BET):

• If L2 = 1 and 2 then BET = L9 - L8	Evacuated from shop
• If L2 = 1 and L9 = ∅ and L10 = ∅ and L11 = ∅ then BET = L12 - L8	Into shop once and out
• If L2 = 1 and L9 ≠ ∅ then BET = L9 - L8 + L12 - L11	Into shop, additional parts ordered, into shop second time

6. **"R" Status Elapsed Time** - Time interval elapsing between entry to "R" status and transition to "S" status. (See Note 2.)

   - "R" Elapsed Time (RET) = L13 - L12

7. **"Completion" Time** - Time interval elapsing between receipt of 2407 at DSU (line 3) and transition to "R" status (line 12), less Delay. (See Note 2.)

   - Completion Time (T) = L12 - L3 - DT

NOTE 1: This interval can be calculated only if L2 = 1 or L2 = 1 and 2 ("normal" shop work or evacuation from shop).

The interval cannot be calculated if L2 = 2.

NOTE 2: This interval can only be calculated if L2 = 1 and L2 ≠ 2 ("normal" shop work only).

SUPPLEMENT 2

PRIORITY CALCULATION SHOWN ON MPS TABLE 9

DEFINITIONS OF TERMS

TH = skill credit threshold for a specific MOS (entered with MPS-9).

M = number of repairmen working in a specific MOS (listed as ASSIGNED on roster).

N = number of repairmen working in a specific MOS whose skill credits on a specific task are equal to or less than threshold.

CSC = collective skill credit—total skill credits on a specific MOS task of all men who have skill credits equal to or less than threshold on that task.

ASC = average skill credit—average skill credit on a specific MOS task of all men who have skill credits equal to or less than threshold on that task.

$$ASC = \frac{CSC}{N}$$

P = priority value used to determine task listing order on MPS Table 9. The same value is rounded and presented beneath the PRIORITY heading on Table 9. Priority is defined as the average skill credit on a particular task divided by the number of repairmen whose skill credits on that task are equal to or less than threshold.

$$P = \frac{ASC}{N}$$

PRIORITY CONCEPT

The maximum skill credit any repairman can receive for any specific task is 7; the minimum is 0. Skill credit threshold (TH) relates directly to these credits. If TH is set at 4, for example, a man with 7 credits has credits above threshold, a man with 4 credits has credits AT threshold, and a man with 0 credits has credits BELOW threshold. (AT threshold and BELOW threshold are considered equivalent for purposes of priority calculation.)

Given a specific unit, MOS, and task, some repairmen will be generally above threshold; the remainder will be at or below threshold. Training should focus on those repairmen who have skill credit equal to or less than threshold. They have the strongest requirement for training.

The formula used to calculate the priority (P) value must yield a lower numeric value as priority "rises" to be consistent with prevailing U.S. Army convention. A priority of "1" is considered higher than a priority of "3," for example, even though the actual numeric value of "1" is lower.

The formula used to calculate P must generate numeric values that decrease as the average skill credit on a specific task decreases and the number of persons who share the skill deficiency increases.

The following formula yields P values that meet the above requirements:

$$P = \frac{ASC}{N}$$

Note that since $ASC = \frac{CSC}{N}$, the earlier formula reduces to the following:

$$P = \frac{CSC}{N^2}$$

CSC will be ∅ if no one has ever done the specific task. In this case, the priority is automatically set to 1.

N will be ∅ if all repairmen are above threshold on the specific task. This will yield a P that is undefined mathematically. This anomaly will be handled by checking the value of N before calculating P and setting P to 7 when N = ∅.

EXAMPLE

Assume that TH = 4, that the MOS has 3 tasks, and that we have task data for 3 repairmen who work in this MOS. Individual skill credit breakdown is shown below.

Repairman	Task 1 Credits	Task 2 Credits	Task 3 Credits
Jones	7*	4	1
Smith	2	2	2
Alberts	3	4	5*

*Skill credits above threshold.

Note that Jones is above TH on Task 1 and that Alberts is above TH on Task 3. The number of repairmen below threshold (N) is therefore as follows:

N:	Task 1	Task 2	Task 3
	2	3	2

Collective skill credit (CSC) on each task is:

CSC:	Task 1	Task 2	Task 3
	5	10	3

Average skill credit (ASC) on each task is calculated from the formula

$$ASC = \frac{CSC}{N}$$

ASC:	Task 1	Task 2	Task 3
	2.5	3.33	1.5

Priority (P) of each task is calculated from the formula

$$P = \frac{ASC}{N}$$

P:	Task 1	Task 2	Task 3
	1.25	1.11	0.75

P could also have been calculated more directly from the formula

$$P = \frac{CSC}{N^2}$$

ROUNDING P VALUES FOR DISPLAY

MPS Table 9 will display only rounded, integer values of P between 1 and 7. The P calculation formula will yield values between ∅ and 7. It is necessary, therefore, to compress the lower end of the scale so that any value of $\emptyset \leq P < 1.5$ is defined (for display only) as P = 1. The P value that will be displayed for various calculated P values is shown below.

Calculated P Values (range)	Displayed P Value
$\emptyset \geq p < 1.5$	1
$1.5 \leq p < 2.5$	2
$2.5 \leq p < 3.5$	3
$3.5 \leq p < 4.5$	4
$4.5 \leq p < 5.5$	5
$5.5 \leq p < 6.5$	6
$6.5 \leq p \leq 7$	7